ILLUMINATING ENGINEERING

SEPTEMBER 1950

National Technical Conference—In Abstract

Part I of Contemporary Lighting for Modern and Traditional Interiors

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

Spellman's Shoe Store, Portland, Ore. Architect: Herzog and Bernat

LUMINOUS LOUVERS

make *ALL* the DIFFERENCE!

The translucent Vinylite louvers specially developed for "Sky-Glo," not only reflect but also *transmit* light to create a NEW KIND OF LIGHT and an entirely new experience in seeing. The special qualities of these plastic louvers diffuse and soften light to provide maximum freedom from glare.

Many types of louver materials were studied and tested before Vinylite was selected by Benjamin engineers. Here is a material that actually glows with light...that creates luminous ceilings so impressively better that overall lighting has become a "best seller" overnight!

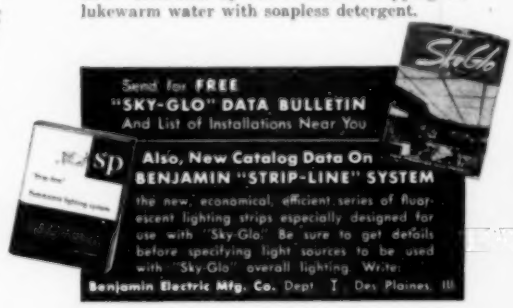
With Benjamin Luminous Louvers, high levels of illumination in the order of 50–100–150 foot –candles–are easily attained without annoying brightness or glare. In fact, so unobtrusive is "Sky-Glo" illumination, that there is no awareness of high levels of illumination...only the sensation of pleasant, restful, inviting, comfortable surroundings.

In maintenance, too, Vinylite "Sky-Glo" louvers are superior. The hard and non-porous surface of "Sky-Glo" louvers resists adherence of dust, dirt and grime. They are easily kept in "like new" condition by an occasional dipping in lukewarm water with soapless detergent.

Louver Ceiling	Efficiency of Material: Light Reflected	Efficiency of Material: Light Transmitted	Average Foot-candles	Coefficient of Utilization	Brightness (Candles Per Sq. In.)	Relative Efficiencies
Without LOUVERS						100.
"SKY-GLO" — Translucent Vinylite	19%	71%	138	.35	1.0	81.6
SYSTEM "A" — Aluminum (2 minute etch)	75.5%	0	119	.30	1.15	70.4
SYSTEM "B" — White Paint, Specular	74.6%	0	102	.26	0.53	60.5

Up to 35% More Efficient and 13% Less Glare

How "Sky-Glo" Luminous Louvers give the user more and better light for his money is shown by laboratory tests of performance with other types of louver materials. Chart above shows typical results of such tests. The data shown was obtained from the Benjamin laboratory experimental room with all conditions carefully controlled. The room dimensions were 15'6"x15'6" with 9'2" from floor to bottom of louvers. Lamps used were 4500° white. Louver cells were 2"x2"x2" providing 45° lengthwise and crosswise shielding.



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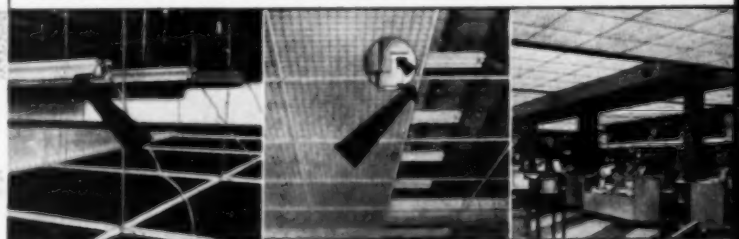
BENJAMIN "Sky-Glo"

LUMINOUS LOUVERED LIGHTING SYSTEM

Sold Exclusively through Electrical Distributors

CEILING BEAUTY TREATMENT...DURING ... AND AFTE



New "Strip-Line" Units by Benjamin are specially designed for "Sky-Glo", are available with and without reflectors.

Louvers are notched to fit in channels; easy to remove and replace.

Final result: an unsightly ceiling conve into a glowing new one without alteration.

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This Salesroom is selling

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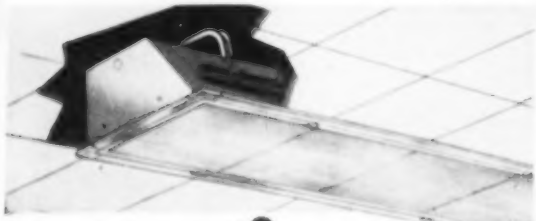
Electrical Engineer: E. R. Ronald & Associates.
Electrical Contractor: Robert E. Berry Electric Co.
Litecontrol Fixtures: No. 5138 — 3 lamp, No. 5128 — 2 lamp, No. BF-H15 — recessed lens box.
Watts per fixture: No. 5138 — 281 w.; No. 5128 — 184 w.; No. BF-H15 — 150 w.
Ceiling height: 15 feet.
Spacing: 8 feet on centers.
Average Footcandles: 42 in service.
*®HOLOPHANE CO., INC.

AFTER DARK, the Litecontrol fixtures in this smart automobile showroom come into their own — illuminating the cars on display in a manner to attract passersby and build sales long after regular business hours. Yet, during the day, they are completely unobtrusive and blend smoothly with the ceiling. There is nothing to distract a buyer's eye from the smart lines and charm of the cars. If you have a problem in lighting showrooms — or any difficult-to-handle-spot — your nearest Litecontrol representative will be happy to assist you in any way.



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is a recessed, Slimline fixture designed to give exceptionally efficient light distribution. Lens may be either Holophane CONTROLENS* or diffusing glass panels held in two hinged frames. Merely loosening the self-retaining catches gives instant and easy access to the inside for servicing.

Catalog Number	Number of Lamps	Housing Length	Housing Width	Housing Height	Trim Length	Trim Width	Approx. Ship. Wt.
5128	2-75W T-12	96"	11⅞"	7⅛"	98⅛"	14"	80 lbs.
5138	3-75W T-12	96"	11⅞"	7⅛"	98⅛"	14"	92 lbs.
5100-3	End cap for individual units or continuous runs						2 lbs.
5100-6	Suspension strap — 2 per unit						3 lbs.

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Fixtures
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DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

SEPTEMBER
1950

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No. 9

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Founded 1906

ILLUMINATING ENGINEERING SOCIETY

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Executive Secretary

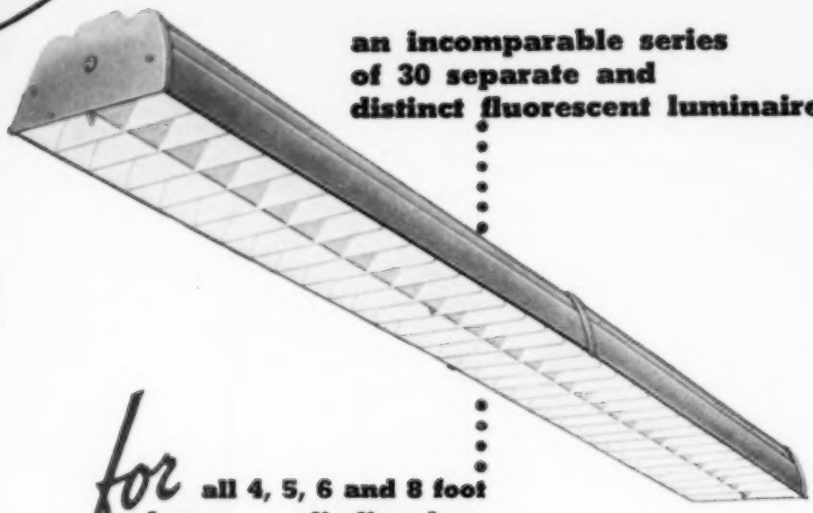
C. L. Crouch
Technical Director

PUBLICATION office 32d Street & Elm Avenue, Baltimore, Md.

EDITORIAL and advertising offices 51 Madison Ave., New York 10, N. Y.

ILLUMINATING ENGINEERING: The Journal of the Illuminating Engineering Society. Copyright 1950 by the Illuminating Engineering Society. Published monthly in the United States of America. Entered as second-class matter at the Post Office, Baltimore, Md. Acceptance for mailing at special postage rates provided for in Section 1103 P.L.&R., Act of October 3, 1917. Authorized July 16, 1918. ¶Subscription $10 per year plus extra postage to all countries to which second-class postage rates do not apply; single copies $1.50. ¶Address changes must be received at IES headquarters by the first of the month to be effective with the issue of the next succeeding month.

NEW CURTIS CORONET



an incomparable series of 30 separate and distinct fluorescent luminaires.

for **all 4, 5, 6 and 8 foot lamps . . . slimline, low-brightness or starter type.**

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Shielded 40° crosswise with either 40° or 25° lengthwise shielding . . . *offering the optimum in eye-comfort.*

Alzak Aluminum or Baked White "Fluracite" steel reflectors . . . *highest lighting efficiency.*

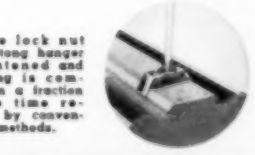
Newly designed "Tong Hangers" speed and simplify installation . . . *Lower installation cost.*

Fingertip control louver catches permit relamping 32 feet of lamps from one ladder position . . . *lower maintenance cost.*

Bears Electrical Testing Laboratories and Fleur-O-Lier labels . . . *guaranteed performance.*

Curtis Tong Hanger already mounted, ready to receive wedge-top of luminaire wireway.

Tongs expand when luminaire is pushed upward in one simple motion. Edges of tongs catch under continuous ridge. Luminaire is released, weight pulls tongs together and assures a strong grip.



Simple lock nut above tong hanger is tightened and mounting is complete in a fraction of the time required by conventional methods.

Full technical details and specifications on the Coronet series are illustrated and described in Bulletin A-1. Write today for your copy. Address Dept. C-815.

CURTIS LIGHTING, Inc.

Appraisal of Modern Fluorescent Lighting Systems

George J. Taylor

ILLUMINATION of offices to levels of 50 footcandles is a building-management factor of some significance in recent years. Space-hungry businesses throughout the land have created a minor boom in the erection of large buildings for office occupancy. Without the usually desirable light space, the owners must attract and hold tenants with such features as good artificial illumination and complete air-conditioning.

Since office buildings, as a rule, are given a fifty-year life for tax purposes, many older buildings are being, or will be, modernized to keep pace with the modern buildings bidding for tenant occupancy.

Adequate lighting requirements for offices have been well defined by the Illuminating Engineering Society. These requirements are more than ever appreciated, though perhaps not fully understood, by building owners and "specifiers" of lighting equipment. The factors involved in achieving these results—comfort, adequate illumination and pleasing appearance—have not been so well delineated, however. Even less understood by most specifiers are the over-all economics involved for an installation meeting recommended practice.

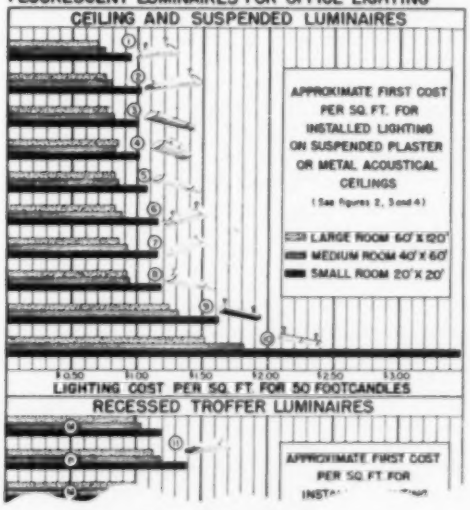
To aid such "specifiers" in the selection of equipment for specific office application, a study has been made of eighteen currently available types of fluorescent luminaires commonly used for office lighting, analyzed from the standpoint of cost, comfort and aesthetics.

In order to analyze each luminaire in relation to the space in which it would be used, three office sizes were selected, each having a 10-foot ceiling. In addition to this, two types of ceilings are considered: (1) Suspended furred metal lath and plaster, (2) Suspended furred metal acoustical ceilings.

Illumination computations were made for the 18 types of lighting systems, in the three room sizes, for the two ceiling conditions, using practical lighting layouts utilizing the best arrangement of luminaires that would provide as nearly as possible 50 footcandles. Where lighting layouts did not provide exactly 50 footcandles, proper adjustments were made to accomplish this result. Therefore, cost comparisons are based on the same level of illumination so that direct comparisons can be made on an equal basis of equal footcandles.

In this study, all pertinent data are tabulated for quick comparison between the lighting systems shown. Also, included in the tabulations are the *cost per square foot* of all the lighting systems, which many architects find useful in their building

CHART I - COST COMPARISON OF TYPICAL TYPE FLUORESCENT LUMINAIRES FOR OFFICE LIGHTING


CEILING AND SUSPENDED LUMINAIRES
APPROXIMATE FIRST COST PER SQ. FT. FOR INSTALLED LIGHTING ON SUSPENDED PLASTER OR METAL ACOUSTICAL CEILINGS
(See figures 2, 3 and 4)
LARGE ROOM 60' X 120'
MEDIUM ROOM 40' X 60'
SMALL ROOM 20' X 20'
$0.50
$1.00
$1.50
$2.00
$2.50
$3.00
LIGHTING COST PER SQ. FT. FOR 50 FOOTCANDLES
RECESSED TROFFER LUMINAIRES
APPROXIMATE FIRST COST PER SQ. FT. FOR

Upper Part — Chart I.

Author: Day-Brite Lighting Inc., New York office.

estimates. These values together with *operating costs* per square foot are plotted which graphically shows increasing costs of the various lighting systems analyzed.

There are five significant factors which have a bearing upon the final selection of the type of lighting system to install. These factors, not necessarily in the order of their importance, may be listed as follows:

1. Comfort—Quality of Illumination
2. Appearance—Aesthetic Effect
3. Maintenance—Lasting Qualities
4. First Cost—Initial Investment
5. Operating Cost—Annual Investment

Whatever weight or importance is assigned to any of the above factors for any valid or special reason will determine the type of lighting system to use. A "rating chart" for the 18 lighting systems analyzed is presented, considering the five factors listed above.

Figure 2. An outstanding application of infrared energy for providing warmth for 20,000 chickens. Four crops of broilers per year are raised from just-hatched baby chicks in this large 50 ft. x 300 ft. structure at Millsboro, Delaware. Each of the 38 units is equipped with 6 250-watt R40 infrared lamps. The complete installation of 228 lamps is connected to a voltage regulator which automatically maintains the proper energy level throughout the period of growth.

Light and Agriculture

J. P. Ditchman

SINCE agriculture is now drawing significantly upon the resources of lighting science to develop improved methods for food production and pest control, its particular requirements should be better known. Only in recent years has lighting for plants and animals been achieving coordinated attention as a factor which can affect a substantial difference in the quantity and character of specific farm crops. As its relation to practical economic considerations in the growth process has become recognized, a wave of interest has been stimulated which has prospects of creating great opportunities for the illuminating engineering profession. There is a great diversity of interests in agriculture now being served in practical production problems by lighting. Of importance is the fact that assumptions made in the well-developed fields of lighting cannot be taken as the basic ones for applications suitable to plants and animals. For these purposes, recommendation should be made with reference to the quite different response characteristics of plants and animals.

As our techniques in various fields have been developing, the broadening demand for applications has made us very much aware of the tendency towards a unity of objectives. That has followed necessarily from the fact that in all other fields we serve the needs of people. In agriculture we serve human wants only indirectly by adopting our knowledge to living things without the fussy visual demands. Plants and animals are content to thrive for human benefit if we concentrate on what we can do to complement and improve their growth process. In this field of service with its quite different scale of values, there are implications that we might someday wish to appropriate for our preferred client, the human being.

Life forms that have only instinctive wants offer very gratifying, dependable responses when we learn how to satisfy those wants faithfully. There are no perceptible subjective reactions to complicate problems and render solutions so contingent as in the case where humans are involved. For example, in the near future the lighting specialist may be discovering valuable information from observation about what is imperative, say, in the life of a fish. Our aquatic friends can't live at all unless their light comes from overhead.

Author: General Electric Corp., Nela Park, Cleveland, Ohio.

A-C Fluorescent Lighting for New York City's Latest Subway Cars

E. W. Beggs H. W. Graybrook

SEVERAL years ago the Board of Transportation of the City of New York decided to build a new type of subway train to test out refinements in car design and fabrication which later might be incorporated in regular New York subway cars. One of the more important innovations was a fluorescent lighting system operating from uninterrupted 60-cycle a-c power with relatively constant voltage and frequency such as is regularly available for general lighting elsewhere.

Such a power system would eliminate the blinking of lights in the cars as the train passes over gaps in the third rail system. It would minimize variations in lighting level with varying power line voltage. It would insure dependable cold weather lamp starting and would eliminate d-c mercury drift which causes one end of a fluorescent lamp to become dim when operated on direct current. It would also allow the use of standard hot cathode fluorescent lamps and equipment. This last would reduce the number of lamps and fixtures and the amount of power required for each car and would permit the use of regular hot cathode lamps which have a minimum dark end at the lamp cathode.

Analysis of the frequency and duration of the gaps in the third rail power system of the New York Subways indicated that to cover all but the most extreme cases, provision should be made to maintain the lights during power interruptions up to 10 seconds duration. A flywheel generator was designed with a 142 lb. wheel, 18⅝" in diameter. This device, operating at 3600 r.p.m., would provide 24.5 kilowatt seconds as the machine slows down to 30000 r.p.m. An actual test of the car showed that this flywheel generator will maintain the lights in the car for about 25 seconds after the 600 volt d-c power is turned off.

The line voltage on the system varies from about 450 to 750 volts. Incandescent tungsten filament lamps vary in lumen output from 35 per cent to 205 per cent with this variation in volts. Under the same condition, d-c fluorescent lamps operating on special resistance type ballasts vary from 55 per cent to 125 per cent in lumens. With the fly-wheel generator and its special voltage and frequency control, the fluorescent lamp lumens vary only from 96 per cent to 106 per cent over the entire range of third rail voltage.

With a-c available, it is possible to provide any secondary voltage desired. Because of this, cold weather starting at any temperature can be insured simply by providing adequate voltage at the generator or from the ballast itself. With the standard 118 volts supplied by the generator, and regular slimline lamps and ballasts, the lamps operated satisfactorily throughout the winter season of 1949-1950.

Special provisions were made to prevent wide variation in frequency as well as voltage, so that standard lead-lag two-lamp ballasts could be used. The narrow variations provided make these types of regular equipment operate with normal balance between the lead lamp and the lag lamp; thus, ballasts do not overheat, and both the lead lamp and the lag lamp operate at about the same output over the range of voltage supplied to the alternator.

The same equipment, or modifications of it, can be adapted to railway car lighting where 600 volts d-c is available from the third rail or the overhead trolley system.

Authors: Westinghouse Electric Corp., Bloomfield, N. J., and Pittsburgh, Pa., respectively.

Figure 2. Interior view showing two continuous rows of dust-tight fixtures per car with 72-inch T-8 hot cathode slimline lamps.

Lighting Fixture Design for Homes of Today and Tomorrow

N. H. Vacha

I HAVE attempted by this paper to answer the often-asked question, "Where do the ideas and influences for lighting fixture designs come from?" It is surprising, when delving into the vast store of written history, to find how important a part Lighting Fixtures, Candelabra, etc., have played in our process of evolution. It is easy to see how this vast background of artistic development has so influenced our lighting fixtures of today.

For centuries the pride of hand-wrought craftsmanship created exquisite pieces of lighting ornament, designed and decorated with the Old-World charm of symbolism and traditional ornamentation. As man progresses, however, natural transformations take place and now in this world of mechanics, we do not have patience for time-consuming handicraft. Our skills and ingenuity are directed toward technological developments, mechanical operations, and assembly lines.

Today's designer of lighting equipment, therefore, is confronted with the task of keeping up to date with the mechanical genius of this 20th century, and, familiar with the knowledge that has been acquired in the technique of lighting during our modern times. He must understand the reasons "for" and "why" of good lighting.

The influence of these technological developments will naturally bring forth lighting products and methods that will be a far cry from those we have known in the past.

Author: John C. Virden Co., Cleveland, Ohio

Specification of Color-Rendering Properties of Fluorescent Lamps

Charles W. Jerome Deane B. Judd

THERE is an urgent need in the fluorescent lamp industry for a measure of the color-rendering properties of these lamps. This has been heightened by the introduction of the "DeLuxe" line of colors which have been developed to give "excellent color rendition."

The present study was undertaken by the authors as part of a sub-committee on color of the American Standards Association's C-78 Committee. No effort is made here to draw positive conclusions nor are any recommendations made. These data will be presented to the Sub-Group and from them will develop definite recommendations for submission to the main committee for action. These data are submitted here in an effort to apprise industry and consumers of the cognizance being taken of this problem and as an introduction to some of the complexities involved in its solution.

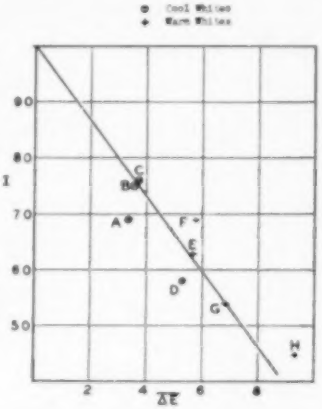


Figure 9. Average energy differences in British bands vs duplication indices.

The National Bureau of Standards has used a procedure to measure color-rendering properties of various light sources. This involves measuring the changes made in three pairs of metameric colors in going from the standard source to any substitute. These changes are combined into a "duplication Index, I," on a scale where 100 represents exact duplication; an index of 50 is approximately the degree of duplication of incandescent lamp light for natural daylight; and the index for monochromatic light by wavelength

Authors: Sylvania Electric Products Inc., Salem, Mass., and National Bureau of Standards, Washington, D. C., respectively.

700 millimicrons for natural daylight is approximately zero.

These computations are a laborious task and are quite unsuited for any quick routine check such as might be employed within a lamp factory. However, they constitute a procedure with which considerable experience has been gained and which gives a quantitative measure of the color rendering properties of illuminants.

In the present study, therefore, we have used these computations to determine the duplication indices of eight different spectral distributions of fluorescent lamps (four "cool whites" and four "warm whites") for black-body radiation of 4500°K and 2848°K (Illuminant A) respectively. We then have used these results as a yardstick of the efficacy of several simpler means of specifying the color-rendering properties of these lamps.

The British use as a measure of the color-rendering properties of fluorescent lamps, the per cent luminosity in eight spectral bands which are chosen as being of equal importance in color rendition. If average energy differences from the standard in these bands are chosen instead of luminosity differences, a fairly promising correlation is found with the duplication indices for our eight test lamps as shown in the illustration.

As indicated, this has been a preliminary study of the problems involved. Although we have not, here, tried to draw any conclusions nor to make any recommendations, our work has encouraged us to believe that a simple workable specification for the color-rendering properties of fluorescent lamps is an attainable goal.

Glow Switch Transients for Starting Fluorescent Lamps

F. H. Rixton

THE trend toward the use of krypton as fill-gas in some fluorescent lamps imposes a more difficult starting problem on fluorescent lamp starters. To insure reliable starting of such lamps it was necessary to improve the transients produced by glow-switches.

Several articles have been published explaining the fundamental design of glow-switches and their function in starting fluorescent lamps. The nature of glow-switch voltage transients and their relation to lamp starting, however, is not widely known. This paper presents a study of a convenient method of measurement of glow-switch transients, the size and nature of such transients, and the effect of design features on the transients. The tests are confined to 20-watt T12 and 25-watt T12 fluorescent lamps and auxiliaries.

Author: Lamp Division, Westinghouse Electric Corporation, Bloomfield, N. J.

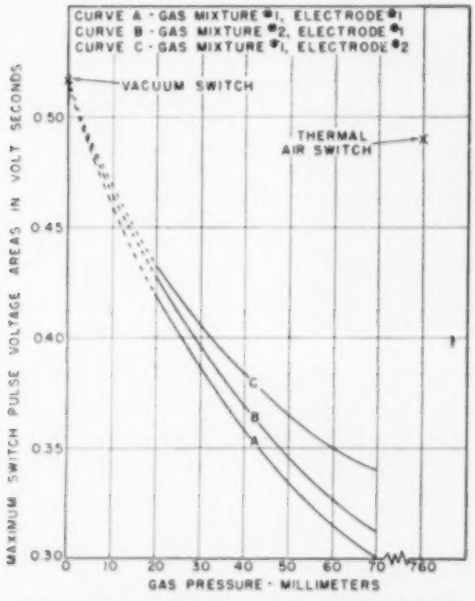


Figure 3. Effect of fill gas mixture and pressure and electrode configuration on glow switch transient voltage areas.

When ballast voltage is applied to a glow-switch a glow discharge is initiated which heats the bimetal strip and causes it to contact the opposite electrode. Preheat current flows through the fluorescent lamp cathodes during the contact period. At the same time the bimetal strip cools and begins to move away from the contact electrode. Upon separation of the contacts, a transient is produced by rapid current change in the inductive ballast. It is this transient which assures lamp starting.

Wave-forms of switch voltages were observed with an oscilliscope. Transient voltage areas were measured by use of an integrating circuit. Mea-

surements of transient voltage areas show that the use of a small capacitor in parallel with the starting switch produces increased areas which is the result of lengthened pulse duration. The greater transient voltage area produces the more reliable lamp starting. The pulse-voltage areas produced by vacuum and thermal air switches are considerably larger than those produced by glow-switches, the vacuum-switch area being the greater of the two. The difference is due to loss of the stored ballast energy being dissipated in the vacuum-switch. The use of glow-switches rather than vacuum or thermal air devices, of course, allows a desired simplification of circuit and auxiliary components, and supplies the demand for a more economical starting device.

As the glow-switch fill-gas pressure is reduced toward the zero pressure condition, the pulse area approaches that produced by a vacuum switch. The ideal glow-switch would produce transient areas approaching the level of vacuum-switch design without materially changing switch breakdown voltage and glow-current characteristics or reducing switch life. In a practical switch a compromise must be made in pulse area by using a suitable gas mixture and pressure to give the desired breakdown voltage, and satisfactory switch life and suitable electrode design to give fast switch closing. The new design glow-switch shown has the advantages of proper electrode configuration and fill-gas characteristics for satisfactory closing time in both inductive and capacitive circuits, and sufficient pulse area for starting krypton-filled lamps such as the 25-watt T12.

The principles of switch design outlined were used as a guide in the design of this new switch.

Reflector Contours for Pressed Glass Lamps

P. F. Dietz

THE present high production of automobiles and the enlarged buying power of the public has greatly increased the number of automobiles on our highways today. This increase emphasizes the need of improved night driving conditions. An important contribution to this problem is the proper design of headlamps.

In the design of lamps of this type, three considerations are of utmost importance, namely: the lens, the filament and its position, and the reflector. The reflector is in effect the heart of the lamp, for its quality will affect the over-all characteristics of the lamp.

When the all-glass sealed-beam lamp was first developed, one of its most important advantages was a more accurate reflector with a longer life for its reflecting surface. The work described is a continuation of that early development in improving the over-all quality of the lamp by obtaining greater accuracy in the parabolic contour of the reflector and the manner in which it is used.

It must be recognized that there are certain positions of the reflecting surface which deviate from a true parabolic contour. While these deviations are small with respect to the over-all contour, they nevertheless appreciably affect the beam pattern produced by the lamp. These deviations are located at the apex of the reflector as well as near its maximum diameter. The detrimental effect of these distortions on the beam pattern produced can be partially eliminated by not including these portions in the reflecting surface of the lamp. This method has a limited application because of beam pattern requirements. The application of this principle must be varied to accommodate the different services of the lamps. Also, in lamps which require prismatic lenses, the lens of the lamp is designed so that the light flux intercepted by the more accurate and consistent parts of the reflector is used in the beam pattern at the most critical points.

Although these distortions do affect the over-all focal length of the reflectors, there is in addition a consistent variation in focal length due to changes in the manufacturing proce-

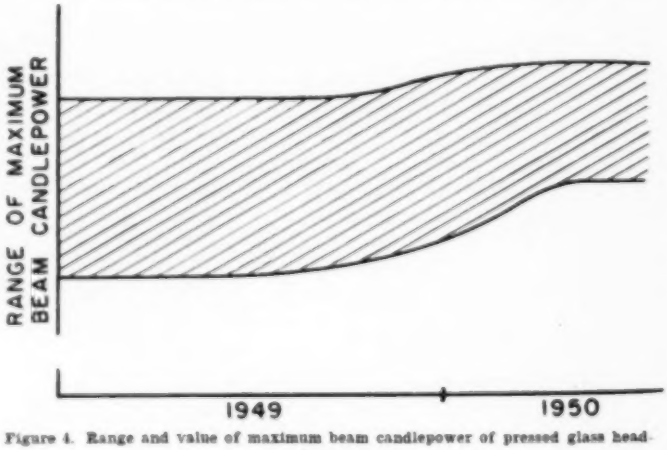


Figure 4. Range and value of maximum beam candlepower of pressed glass headlamps.

Author: Engineering Department, Westinghouse Electric Corp., Bloomfield, N. J.

dure. Under a given set of manufacturing conditions the characteristics of the parabolic surface are very uniform. As manufacturing conditions change, minor deviations in the reflecting surface are found. By segregating glassware into groups of like characteristics and providing the optimum filament location for each group, the effect of these minor variations has been minimized.

In the manufacture of lamps of the pressed-glass type, excellent results have been obtained by making use of these principles in properly placing the filament with respect to reflector.

This is shown graphically in the accompanying illustration where the maximum beam candlepower values obtained have been plotted chronologically. It may be seen that the method described has resulted in an increase in the maximum beam-candlepower values obtained, as well as reduction in the over-all spread of the individual values. This is illustrative of an over-all improvement in the entire beam pattern.

New Glass Developments in the Field of Illumination

Dr. W. W. Shaver

RECENT developments in glass have produced two new types with interesting properties in the lighting field.

The 96 per cent silica glasses have unusual heat resistance, both as to heat shock and softening temperature. These glasses are made by a unique process which has been called the only new development in glass making since glass melting began. Alkali borosilicate glasses melted and formed by conventional methods to the desired but oversized shape are then subjected to a heat treatment followed by imersion in a dilute acid bath for a period of time depending upon the wall thickness. In the acid bath, the soluble materials in the glass are leached out, leaving a porous structure of 96 per cent silica composition, with the product having the same size and shape but weighing one-third less. In the final step in the process, the porous glass article is heated to a high temperature, causing a predetermined linear shrinkage of some 14 per cent in all dimensions. This final 96 per cent silica glass has properties comparable to those of fused silica with the advantage that it can be made into products by conventional glass-forming methods which are entirely impractical for fused silica on account of its high working temperature. Suitable graded seals for bridging the gap between the 96 per cent silica glasses and tungsten, molybdenum, or special metal alloys have been developed and are commercially available.

These high-silica glasses have interesting possibilities in many fields. One type with high ultraviolet transmission and low solarization rate is being used as an envelope for germicidal lamps. With the unusual heat resisting properties of these glasses, it is possible to design high wattage incandescent lamps with much smaller envelopes than previously have been used. Cover glasses and lenses can be made in these glasses for use with light sources of extremely high wattage where temperatures are such as to prohibit the use of the well-known heat-resisting glasses.

The second type of glass having applications in the lighting field is the new photosensitive glass in which patterns or pictures can be made right in the glass itself by a photographic proc-

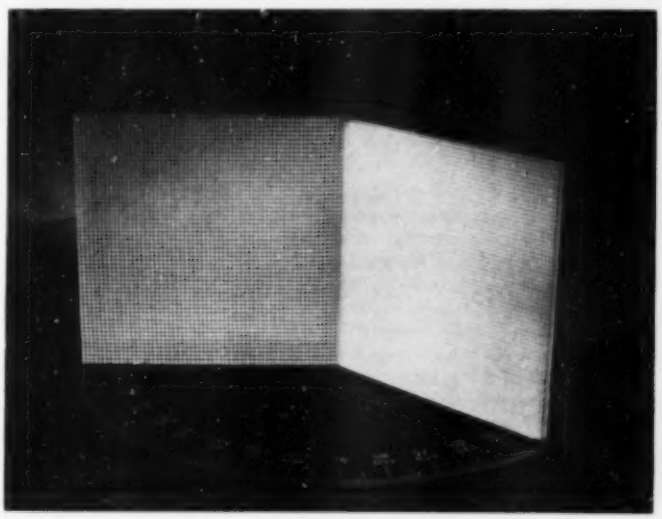


Figure 6.

Author: Corning Glass Works, Corning, N. Y.

ess, giving minute detail and various color tints. These glasses are clear, high-quality glasses melted and manufactured by conventional glass making methods. The production of a pattern or picture in the photosensitive glass medium consists of two parts — exposure and development. Ultraviolet light is used for exposure, with energy in the wavelength range of from 300 to 350 mm. Final development of the picture consists of a heat treatment which includes heating the glass to a temperature somewhat above red heat for a period of 5 to 60 minutes and then cooling it slowly to anneal.

A second photosensitive glass produces a white or tinted opal on exposure and development, with many possible lighting applications. Various patterns of louvers or vanes can be developed in this glass in the form of rolled sheet or polished plate. Flat sheets $\frac{1}{8}$ inch thick developed with a louvered pattern such as the egg crate design having approximately $\frac{1}{4}$ inch spacing may be used with various types of light sources to control the distribution of light with a cutoff at an angle of 45 degrees. Such louvered glass in combination with a good reflector produces an efficiency of 70 per cent or above.

Recent Developments in High Wattage Tungsten Lamps

Richard G. Slauer

ALL high-wattage tungsten lamps have been circumscribed by the same factor — heat as it affects the glass bulb and inner mount. The recent introduction of a 96 per cent silica glass, suggests that such restrictions may now be greatly modified. The operational limit of this new glass is about 800°C as compared with the 400°C of previously-used glasses.

An initial investigation has resulted in the tentative standardization of a line of 3 infrared lamps for use in domestic electric ranges, replacing the conventional sheathed coil surface element. A wattage of 1250 is housed in a bulb of about the same size as the 150-watt PAR-38 hard glass lamp, perhaps the most comparable for thermal shock applications.

The infrared stove lamps are of two-piece construction, fused at maximum diameter. A graded seal forms the major part of the bulb neck in order to bridge the gap between the working temperatures of the new glass (over 1500°C, necessitating a furnace) and borosilicate glasses (under 1000° C, therefore workable under external gas flames). Evaporated gold is used for the reflecting surface.

For electric-range use, the lamp is placed under a top plate of the new glass tinted to a red color. The latter serves as an effective surface on which to place pots and pans, it absorbs 98 per cent or more of the visible energy, and it prevents cooking spillage from reaching the inside of the range. The order of magnitude of operating efficiency, maintenance, and life are about the same as for conventional units; the cost, for the present, somewhat higher. Its advantages, as compared with conventional units, are (1) instant heat, (2) visible indication of heat, (3) more uniform heat, (4) smoother range top, (5) easier cleaning, and (6) higher speed for small quantities of food.

The use of the new glass for domestic ranges does not imply any limit to other infrared uses. A universal-burning industrial infrared lamp could deliver 20 watts per sq. in.; a restricted-burning lamp perhaps up to 30. Since protection from thermal shock is increased by a factor of 8, it is almost fool-proof on this basis. Ice water on a 1250-watt lamp with a surface temperature over 600°C creates no destructive strain. Universal-burning lamps naturally present special problems if excessive temperatures are allowed to affect the sealing area (borosilicate glass) but the available

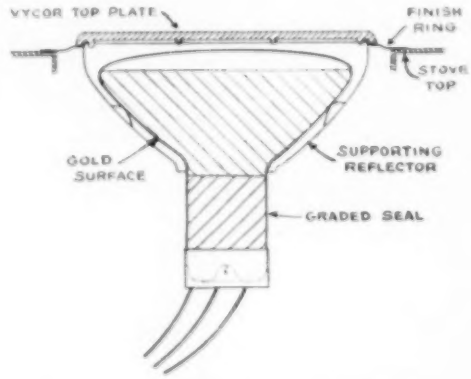


Figure 2. Infrared cooking lamp assembly diagram.

Author: Sylvania Electric Products Inc., Salem, Mass.

margin seems ample for effective lamp design.

As important as infrared uses for this new glass, are suggested uses in the lighting field, particularly for outdoor use. A 1000-watt lamp would weigh under a pound and would need no auxiliaries except to protect the electrical contacts against rain or other forms of moisture. The lamp would be both physically and thermally rugged. Possible applications include sports lighting where a minimum initial investment is desired, gasoline service stations, and temporary lighting for outdoor construction. Because lamps of this material are new, these lighting applications are still in the suggestion stage with actual data limited to casual sampling and experimentation.

insulated sockets and this insulation must not be allowed to reach a temperature at which its insulating properties are destroyed.

To establish a standard for the maximum allowable operating temperature for this insulation, "typically hot" type fixtures were selected and measurements made with the maximum wattage standard lamp which they would accommodate. The lamp was also one that had been on the market in its present form and in comparatively large quantities over a long enough period of time to establish its acceptability in reference to its effect on the socket insulation.

The 100-watt coiled-coil filament lamp was standardized in the A21 bulb in 1938. The dimensions were the same as those for the then established 75-watt single-coil A21 bulb lamp and could be used in fixtures which, up to that time, could accommodate only 75-watt lamps as a maximum. On the

Bulb Sizes for Incandescent Filament Lamps

W. E. Anderson

THE trend towards smaller bulb sizes for incandescent filament lamps for general lighting purposes over the past half century has played a large part in promoting the principle of "Better Light-Better Sight." It has promoted the use of lamps of higher wattage in fixtures formerly limited to lamps of lower wattage.

The history of research and development in the lamp industry over the years has been one of continual improvement in lamp efficiencies and quality. Vacuum lamps gradually gave way to gas-filled lamps in the higher wattage bracket. The gas in gas-filled lamps changed from pure nitrogen to higher and higher blendings of argon gas. Filament shapes changed from straight uncoiled filaments to single coil and coiled coil. With all these improvements bulb sizes became smaller and smaller.

These changes and improvements finally brought about a situation where lamp operating temperatures became a major factor in determining the size of the bulb to be used, and of final lamp dimensions for over-all length and light center length, particularly in gas-filled lamps for residential service. The majority of these lamps are used in fixtures equipped with fiber-

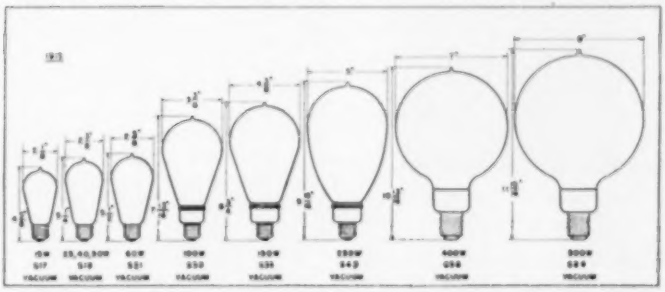


Figure 1. Bulb shapes and sizes for general lighting lamps — Year 1915.

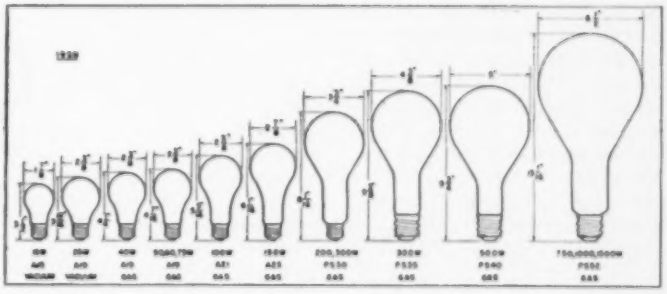


Figure 2. Bulb shapes and sizes for general lighting lamps — Year 1950.

Author: Westinghouse Electric Corp., Bloomfield, N. J.

premise that the 100-watt A21 bulb lamp has now been standard and on the market for over ten years and that a sufficient number have found their way into these "typically hot" fixtures to establish their acceptability, the socket temperature thus obtained was adopted as a criteria by which to determine whether the bulb size for the 75- and 150-watt lamps could be reduced when a change to the more efficient coiled-coil filament shape became practical.

Test results showed that this could be done and, as a consequence, the 75-watt lamp was changed last year to a coiled-coil filament shape in an A19 bulb with lamp dimensions the same as the present 60-watt lamp, and the 150-watt lamp changed this year to a coiled-coil filament shape in an A23 bulb of the same lamp dimensions as the 100-watt lamp which was standard prior to 1938.

Because of these changes, illumination levels may now be raised as much as 35 per cent with fixtures formerly limited to 60-watt lamps and approximately 60 per cent with fixtures formerly limited to 100-watt lamps.

Thermionic Cathodes for Fluorescent Lamps and Their Behavior

Erwin F. Lowry

THIS paper discusses some of the peculiarities of fluorescent lamp cathodes and factors which influence their operation. Lamp loading has an important influence on cathode life and on the visual defects which arise from cathode disintegration. The hot-spot on the coating of a 40-watt cathode actually is hotter when the lamp is operated at 100 ma than it is when operated at 600 ma. For optimum performance, lamps should be operated close to design values. At currents either too high or too low, end-discoloration on the lamp becomes excessive and lamp life is shortened.

Since these cathodes are heated chiefly by electron bombardment during the anode half-cycle, the use of auxiliary anodes required the cathodes themselves to be smaller than otherwise would be necessary. Elimination of these appendages permitted the use of larger cathodes with more coating and resulted in lamps of longer life.

Electrical characteristics of the ballasting equipment used have a very important effect on lamp behavior. Lamp-life, lumen output and efficiency, and flicker are all affected by ballast characteristics. For best results, a ballast should have a form-factor approaching as closely as possible that of a straight-line reactor. Tests have shown that if the ballast has a form-factor or peak-to-R.M.S. ratio of 2 instead of the preferred 1.5, lamp-life may be decreased to one-half its normal value. Stroboscopic effect or flicker is closely proportional to the form-factor value, thus poor form-factor results directly in excessive flicker. Photometric data on lamps operated with ballasts of poor form-factor invariably show that the luminous efficiencies of the lamps are slightly less than for the same lamps on ballasts with good form-factor.

For many years, rated lamp-life was limited to 2500 hours although the actual life averaged about 4000 hours. End-discoloration after two or three thousand hours burning usually was such as seriously to impair the appearance of the installation. As the result of a long continued series of investigations undertaken in our laboratories, it was found that the addition of a small amount of zirconium oxide to the coating had the startling effect of more than doubling lamp-life and appreciably delaying the formation of end-discoloration.

In brief, this paper shows that:

1. For optimum performance, lamps should be operated at the current for which the cathode is designed.
2. Auxiliary anodes are non-essential except in certain specialized cases.
3. Lamp-life and other characteristics are seriously affected by poor form-factor of the ballasting equipment.
4. A new cathode-coating formulation has more than doubled lamp-life and materially reduced end-discoloration.

Author: Sylvania Electric Products Inc., Salem, Mass.

New Photochemical Lamps

L. E. Barnes

NEW photochemical lamps have been developed using new glass and new electrodes which are better adapted to the operating conditions of modern whiteprint machines. They have higher ultraviolet output, more uniform output because of reduced sensitivity to drafts and longer life which is practically independent of the number of times lamps are turned on. The new lamps are shown in the accompanying illustration.

Author: Lamp Division, Westinghouse Electric Corporation, Bloomfield, N. J.

Figure 1. 3000-watt, 56" C-H9 lamp and 940-watt, 21½" A-H14 lamp.

"Diazo" compounds used as a sensitized paper emulsion in whiteprint processes have a spectral sensitivity in the ultraviolet region adjacent to the visible spectrum. A medium pressure mercury arc is used to obtain the best efficiency of output in this spectral region. To accommodate high operating temperatures necessary to vaporize the mercury, it has been customary to use high-temperature glasses and fused quartz for arc tubes. However, the low transmission of such glass at high temperatures, and the problem of ozone when quartz was used, made these materials unsatisfactory. In recent years a new high-temperature glass with neither of these objectionable features has become available. The new lamps are made of this new glass.

The sensitized paper used in the whiteprint process should not be heated above 135°F, to avoid objectionable blurring due to the difference in expansion of the tracing and emulsion. To maintain low emulsion temperature, a cooling draft, which incidentally cools the lamp, is used. Mercury vapor lamps operate at a pressure determined by the coolest part of the lamp. In conventional tubular lamps, a critical spot has been the exhaust tip. In the new lamps the exhaust tip has been completely eliminated. The elimination of the exhaust tip not only has reduced the problem of lamp operation in drafts but also made unnecessary the special education of consumers to position the lamp with the exhaust tip at the warmest operating position.

Use of the new glass also permitted a reduction in bulb diameter. This reduced the area of the bulb exposed to the cooling draft thereby reducing sensitivity to drafts still more. The reduction in sensitivity to drafts results in uniform output along the length of the lamp.

The duty cycle of most photo printing machines is four hours per start. Some are used for even shorter periods. Electrodes and some photochemical lamps are of an oxide activated type which have a tendency to sputter emission material from the electrode when subjected to repeated starts and thus become deactivated. The new lamps use thorium (non-activated) electrodes which have the advantage of long life practically independent of the number of starts.

Lighting for the Home Sewing Machine

Myrtle Fahsbender Priscilla Presbrey

IN this paper, a continuation of a previous report on lighting for hand sewing in the home, the authors endeavor (1) to determine the visual task involved in machine sewing and the lighting conditions most satisfactory for the purpose, and (2) to appraise various types of suitable equipment on the basis of the quantity and quality of the illumination they supply.

Hand sewing usually requires close concentration to place the needle for each stitch, and the amount and quality of the illumination greatly affect the ease with which it can be done. In machine sewing, the eyes do not have to select the exact point at which the needle enters the material; the task is primarily one of feeding the fabric through the presser foot and guiding the line of stitching in the desired direction. There is rapid motion in machine sewing, but the eyes are not trying to watch the needle as it moves up and down. In general, the authors believe that machine sewing is a less exacting visual task than most hand sewing.

Nevertheless, machine sewing needs careful lighting for desirable sewing conditions. Observations indicate that the area to which critical attention is directed during stitching is a relatively small one immediately around the

Authors: Westinghouse Electric Corp., Bloomfield, N. J.

needle. The shape of the machine makes it difficult to obtain a uniform distribution of light on this area, in that light coming from any direction casts a shadow from some part of the machine. Some of these shadows are particularly distracting because they seem to "jump" when the machine is in motion.

To make an effective comparison of the lighting performance of available equipment that might be suitable for machine sewing in the home, it was necessary to establish some definite test areas on which measurements could be taken. The immediate test plane selected was a horizontal area six inches square, centered laterally on the needle and extending two inches behind it and four inches in front. In addition to light on the small critical work area, there should also be light over a larger area, chiefly to the left of the machine where fabric is handled and arranged. Therefore a secondary test plane was established, extending 18 inches to the left and six inches to the right of the needle, and six inches both in front and in back. Footcandle measurements were made at seven points in the immediate test plane and ten additional points in the secondary test plane. A distance of 30 inches from floor to test plane was chosen as a reasonable height for either a console-type machine or a portable machine on a table. All tests were made in a standard test room.

Tests of various types of machine lights showed that lighting equipment placed anywhere on the machine produces harsh shadows somewhere on the immediate test plane. Locating the light at the front of the machine arm places the shadows behind the presser foot, where they are least objectionable. Since machine lights at best give a very limited spread of light, another local source is necessary to illuminate the secondary test plane and the front of the machine.

Tests and footcandle readings made with a variety of lighting units, including conventional styles of floor, table, and wall lamps as well as reflector and projector lamps, were investigated as sources of supplementary light. Observations indicate that the operator can see to do machine sewing about equally well with either directional or diffuse light. However, the larger and more diffuse the light source, the softer and larger and less prominent are the inevitable shadows. Lamps with diffusing bowls give reasonably good results in this respect, but they are still somewhat less desirable than fluorescent sources. No difficulty was experienced with specular reflection from shiny fabrics, or with stroboscopic effect from a single-lamp fluorescent unit.

With a console machine, almost any type of luminaire can be placed in a suitable position as a supplementary light source. With portable machines, the application of certain types of equpiment is somewhat limited. With three possible exceptions, all the luminaires tested require additional general lighting in the room to reduce brightness contrasts between the brightly lighted working area and the rest of the room, and to supply adequate illumination on the front of the machine for the various operations performed there.

Fluorescent Lighting in the Home

E. W. Commery

Kaye A. Leighton

A CRITICAL and comprehensive group of observations of the color rendition qualities of six sources of light, including the four newest fluorescent lamps, have been made in this study. These are analyzed and summarized for practical interior designing. The lighting and interior designer is supplied with much that is basic for predicting the results that may be expected from each of these fluorescent lamps, when used alone or for the separate illumination of various parts of a given interior. The color rendition qualities of the incandescent filament lamp and a selected artificial "daylight" have also been studied alone, and in comparison with the fluorescent lamps. Trends toward whiter light sources in this field are discussed.

Illustrations of some of the more advanced uses of fluorescent lamps in residential interiors from those found in the modest small home to the more pretentious, comprise the second part of the paper. These are clarified through lighting measurements of performance and with section and perspective drawings of the lighting techniques employed.

Authors: General Electric Co., Nela Park, Cleveland, Ohio.

Effective Practice in Lighting Unusually Hazardous or Irregular Roadway Areas

P. M. Swetland J. S. Lindsay

WHILE the existing manual, "American Standard Practice for Street and Highway Lighting," constitutes the most authoritative and complete guide for modern street lighting practice, the unavoidable limitations of such a code preclude detailed recommendations and suggestions for effectively lighting many of the more unusual roadway areas with which the street lighting engineer must deal.

Consequently, the primary objective of the authors, in this paper, is outlining of the "problem and advised lighting treatment" incident to five of these somewhat special roadway sections.

1. *Severe Roadway Curves and Steep Grades.* Along pronounced curves, experience indicates that maximum visibility is obtained only by positioning luminaires along the outer curb of two- to four-lane roadways—with possibly a both-side location required for wider pavements. On steep grades (5 deg. and more) it is essential to align modern pendent luminaires with the major axis perpendicular to the roadway plane, if satisfactory visibility is to result to traffic flowing in both directions.

2. *Low Mounted Fluorescent Lamp Installations.* It is often necessary to illuminate roadways on bridges, viaducts, ramps, through underpasses, and in close proximity to airport runways, by luminaire equipment mounted only a few feet above the pavement. Of late, enclosed reflector units equipped with either 6-ft. or 8-ft. slimline fluorescent lamps are available, as one effective solution to this problem.

3. *Severe Foliage Conditions.* As is quite well known by street-lighting engineers, severe losses in night visibility are all too frequently occasioned by heavy and improperly controlled tree foliage. As one aid toward solving this problem, the authors submit a foliage trimming chart relative to modern luminaire usage.

4. *Positioning Luminaires a Considerable Distance Back from the Pavement Edge.* Local right-of-way regulations sometimes make it necessary to illuminate a roadway by luminaire equipment located 30 to 40 ft. back from the traffic lane. Fortunately, this admittedly difficult problem is minimized at times when dealing with secondary highways, requiring only a medium level of illumination and visibility.

A vertilateral type of pendent luminaire is available for this purpose, having a Type I distribution, with a relatively high angle of maximum candlepower and a pronounced lateral cutoff which, when properly tilted and spaced linearly, produces very satisfactory results.

5. *Daytime Lighting of Tunnel and Long Underpass Entrance Sections.* Perhaps the most difficult problem facing street-lighting engineers, is this

Figure 2. View of excellent pavement brightness uniformity resulting from proper positioning and design of luminaires.

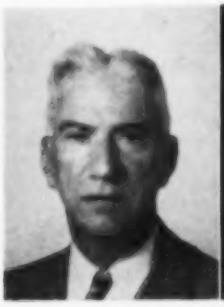
Authors: General Electric Co., Lynn, Mass.

matter of effectively and economically minimizing the sudden loss of visibility as the motorist enters a straight tunnel section from bright sunlight conditions outside.

The authors submit proven remedial measures, together with additional recommendations, with reference to both urban tunnels having generally reduced vehicular entering speeds and less severe external sunlight conditions, and to tunnels on high-speed highways which require the maximum in experience and resourcefulness in effecting a satisfactory solution.

It is hoped that this paper provides practical solutions, plus some stimulation toward further investigation, relative to these more irregular and more difficult roadway lighting problems.

Lighting of the Brooklyn-Battery Tunnel



Leo Geenens

Kirk Reid

THE lighting technique employed in the Brooklyn-Battery Tunnel, new vehicular link between Brooklyn and New York, departs radically from former practices. The objectives—and the innovations employed to achieve them—may be outlined as follows:

Objective 1: A cheerful, inviting appearance of the lighted tunnel. Achieved with high efficiency by distribution of light from luminaires largely to adjacent white-tiled sidewalls and ceiling, rather than directly to the pavement. High efficiency maintained by frequent washing of both tunnel and lighting equipment.

Objective 2: Pleasant and comfortable driving, without flickering shadows and highlights and the effect of successive flashing of lights in motorists' eyes. Achieved by use of fluorescent lamps, of low brightness, in two virtually continuous lines, one along each tunnel wall near the ceiling.

Objective 3: Flexibility of illumination level, readily controllable to take into account the outdoor light condition, state of cleanliness of tunnel walls and ceiling, and possible future trends in lighting standards. Achieved by series-type circuits, with current in all circuits controlled from one location. Other than in the entrance sections, cold-cathode fluorescent lamps are operated at current values ranging from 50 ma in summer up to 120 ma in winter.

Objective 4: Satisfactory eye adaptation of motorists entering the tunnel on bright days. Achieved by "stepped-up" lighting within each entrance, employing slimline (hot-cathode) fluorescent lamps. Lamps are operated at currents as high as 450 ma just inside the portals, with progressively lower currents down to 75 ma throughout 1800 feet.

Objective 5: Continuity of illumination. Possibility of "blackout" minimized by use of four circuits, two from Manhattan and two from Brooklyn. Groups of six luminaires — each approximately 75 linear feet in length, are staggered among the four circuits.

Objective 6: Safety of maintenance crews. Achieved by minimizing traffic interruption through use of high-speed washing facilities and two-lamp assemblies designed for quick replacement. A special push-pull socket safeguards lamp replacement personnel.

Objective 7: Low cost of lighting installation. Achieved by series circuits of relatively small wire, by grounded returns on the secondaries of the insulating transformers, and by luminaires moderate in cost and not of "built-in" design requiring special construction of sidewall or ceiling.

Objective 8: Low cost of lighting operation. Achieved by the high efficiency and long life of fluorescent lamps, by facilities for rapid washing and lamp replacement, and by rugged, long-life equipment construction.

Figure 1. Even illumination and moderate brightness contrasts enhance the cheerful appearance of the tunnel and set a new standard of motoring comfort.

Authors: Triborough Bridge and Tunnel Authority, New York; and General Electric Co., Nela Park, Cleveland, Ohio, respectively.

Lighting the Mystic Bridge

W. J. McClain

THE Mystic River Bridge is a new highway facility approximately 11,000 feet long between Boston and Chelsea. The structure, consisting of two decks, bridges the Little Mystic River, the Boston and Maine Railroad terminal at the Mystic docks, and the main branch of the Mystic River. The upper deck of the bridge carries three lanes of southbound vehicular traffic between Chelsea and Charlestown, and the lower deck carries three lanes of northbound vehicular traffic.

During the early design stage of this bridge, the engineers decided this structure should not have overhead roadway lighting of the conventional type on poles, but should have a lighting system designed as an integral part of the bridge and concealed as much as possible.

As all traffic movement on each deck is in one direction only, it became possible to conceal the light source from the motorist's view by utilizing a lamp housing made a part of the hand-rail post and aimed in the direction of the moving traffic. A sealed-beam automobile type lamp was selected for its ease of mounting, control of light, and well-known rugged characteristics. This lamp is the SAE-4012, rated 35 watts at 6.2 volts. The lamp filament is very rugged and is shielded, and of course the reflector being an integral part of the PAR-46 bulb is renewed with each lamp change. The original light output of the sealed beam lamp is practically unchanged at the end of its life. The normal lamp life of the SAE-4012 lamps as installed on the bridge is extended by means of under-voltage operation so the renewals are expected to average three lamp changes per year. The lamps are burned at 90 per cent of design voltage between turn-on time and midnight and 85 per cent of design voltage between midnight and turn-off time.

Author: J. E. Greiner Co., Baltimore, Md.

Relamping is easily accomplished from the emergency walkway along the bridge rails. The bridge patrol cars at night clip a tag on the visor of a housing containing a burned-out lamp and report the quantity and location to the bridge maintenance force.

The lamps are located "opposite" in the bridge handrail posts on each side of the roadway 4 feet above the crown and 42 feet across, with approximately 52-foot longitudinal spacing. The installed lamp is aimed in the direction of moving traffic and is turned 6 degrees toward the center of the roadway and 2 degrees down.

The sealed-beam lighting system connected load for 22,000 feet of roadway is approximately 32 kilowatts, which is distributed to the individual lamp transformers by means of two 600-volt single-phase 2-wire circuits in each handrail.

Photo by Fairchild Aerial Surveys, Inc.

Airview of Mystic River Bridge.

Temperature Problems in Street Lighting Luminaires

R. W. Loehr

EQUIPMENT failures resulting from high temperatures encountered in street lighting luminaires have always presented serious problems to municipal and utility operating departments. This paper presents an analysis of some of the problems encountered.

Author: Westinghouse Electric Corp., Bloomfield, N. J.

Particular emphasis is placed on problems relating to failures of sockets and receptacles.

Although the socket or receptacle usually receives the blame when a failure occurs, the trouble is often found to be caused by faulty operation of other components. In many cases, film cutouts do not break down following a hot filament failure, and an arc develops within the lamp bulb, resulting in destruction of the socket. Even if the cutout does break down, the resistance of the cutout may be high enough to develop temperatures of sufficient magnitude to destroy the socket.

In studying these problems, even the lamp itself cannot be ignored. Inspection of high wattage series lamps taken from service has revealed that a high percentage of lamps develop air leaks prior to failure. This leakage results in a tungsten oxide deposit, usually of a blue color, on the inner bulb wall. Socket and receptacle temperatures encountered with such lamps are materially above those resulting from normal lamps. This temperature increase is partially due to absorption of energy by the coated bulb wall, and partially due to a substantial increase in lamp wattage prior to burnout.

Functional Lighting in Canadian Church Buildings

H. C. Jones

IT is fitting that church buildings should be adequately lighted, because light is the symbol of eternal truth. Although light itself is changeless, the methods of applying it to churches, as to other interiors, has undergone a radical change in the past few years. Lighting serves both for use and for decoration. Enough light should be provided so that even older people may be able to read Bibles, hymn books, or prayer books at any seat in the auditorium. The I.E.S. standard of 10 footcandles for church auditoriums has been adopted in most Canadian lighting or relighting jobs, and in many cases has been exceeded.

In the ritualistic church, the altar is the predominant feature, and should be lighted to a higher value than the rest of the church. Usually sufficient space is available behind the chancel arch to conceal floodlights. If there is a canopy or other projection, the direction of some light to it from below, perhaps from some other part of the altar itself, may be necessary.

In evangelical churches, more stress is laid on the message in word and in song. Consequently the pulpit, the lectern, or the choir loft are made to be the most brightly lighted areas in the building.

Where the nave has a plastered ceiling with space above, flush recessed downlights with prismatic glass or louvers to control the beam of light have proved successful. In the sloping portion of the ceiling, it is necessary to use a special unit adapted to the ceiling slope. Where beams are exposed, these provide suitable shielding for the lighting units. Accent lighting for choir, lectern, pulpit, or communion table also can be provided from units in front of the beams.

Some light is desirable on the ceiling, to relieve contrasts, and to bring out the beauty of paintings or decorations.

Holy Name Roman Catholic Church, Toronto, exemplifies some of the principles of functional lighting. (See accompanying illustration.) 500-watt silver-mirrored reflector units, with glass cover and concentric louvers, illu-

Figure 1. Holy Name Church in Toronto. 500-watt louvered reflectors are recessed flush with the ceilings. 150-watt projector lamps floodlight main and side altars.

Author: Canadian General Electric Co., Ltd., Toronto, Canada.

minate the nave. Units are placed in front of the shallow beams, which give some measure of shielding.

The main altar is emphasized by floodlights above the ceiling in front of the sanctuary arch. Projector lamps at the side help to soften shadows. Pictures in the dome are illuminated by projector lamps behind the altar. Side altars are revealed by reflector flood lamps directed downwards. Ceiling illumination is provided by banks of reflector flood lamps above doorways in the transepts and at the front of the balcony rail.

The co-ordination of direct and indirect lighting has produced a balanced and pleasing effect.

A Method of Evaluating Fluorescent Luminaires

Kurt Franck

THE introduction of fluorescent lamps up to 8 ft. in length has made necessary considerable changes in the methods of photometric testing and evaluating fluorescent luminaires. It is a well known fact that to have the term "candlepower" be meaningful — *i.e.*, to have the inverse-square-law apply for accurate calculations — the photometric test distance should equal or exceed five times the largest dimension of the luminaire under test.

For 8-ft luminaires this would mean a testing distance of 40 ft; with some sacrifice in accuracy, this 40-ft distance can be reduced to 20 ft, but even a 20-ft test distance is difficult to obtain in practice.

There is another point to consider: Accurate and dependable photometric test results are not an end in themselves, but a means to an end; namely, to calculate lighting results in advance of actual installation, whether the calculations be of a general type as for the so-called flux of light method or of the more specific type as in the so-called point-by-point computations. It must be borne in mind that what applies to minimum test distance in photometric work also applies to the evaluation of photometric results in terms of footcandle values; if the illumination in footcandles is to be computed from the candlepower distribution of an 8-ft luminaire, the results will be accurate only if the work plane is located at a distance from the luminaire of five times the maximum dimension of the unit.

My proposed method aims at solving these two problems of test procedure and test evaluation at the same time. The method consists of breaking down the long fluorescent luminaire into "elements" of shorter length, both for test and for test evaluation. 2-ft elements are proposed for greater accuracy, and 4-ft elements for an accuracy sufficient for most installation conditions.

Assuming a choice of 2-ft elements, the process is to consider the (say, 8-ft) luminaire to consist of four 2-ft sections to be tested separately and later to be evaluated separately for footcandle results on the work plane. Five times the length of a 2-ft element, or 10 ft, gives a test distance which can be obtained readily in the laboratory with the luminaire mounted horizontally exactly as in its final operating condition; also, a 10-ft distance works out well for evaluating from photometric test plots the performance results of actual installations.

Stating the aim of the proposed method in different form, it might be said that by breaking down a long luminaire into short elements we are in effect replacing the linearly extended luminaire by a series of "point" source luminaires at 2-ft spacings; both testing and test evaluating then can proceed for these virtual point-source luminaires in the standard manner long established for incandescent point source luminaires.

The paper describes test and evaluation procedure and calls attention to precautions which must be taken in the use of the "element" test method. It further proposes methods of presenting the test results and shows the use of elements for test evaluation by way of an example of actual installation conditions.

Author: Holophane Co., Inc., New York, N. Y.

Lighting the School Auditorium and Stage

Carl J. Allen

THE interest in school auditorium and stage lighting recently has been greatly accelerated. This has particularly come about in those schools where lighting conditions have been improved in the classrooms and school officials have taken a critical look at the conditions in their auditoriums. Even a casual inspection of existing schools will show that, lighting-wise, the auditoriums and stages are far from what they might be.

This paper formulates the principal lighting requirements of the school auditorium and stage and offers a range of suggestions which will meet various size budgets. Auditorium lighting is considered in the paper to be

Author: General Electric Co., Nela Park, Cleveland, Ohio.

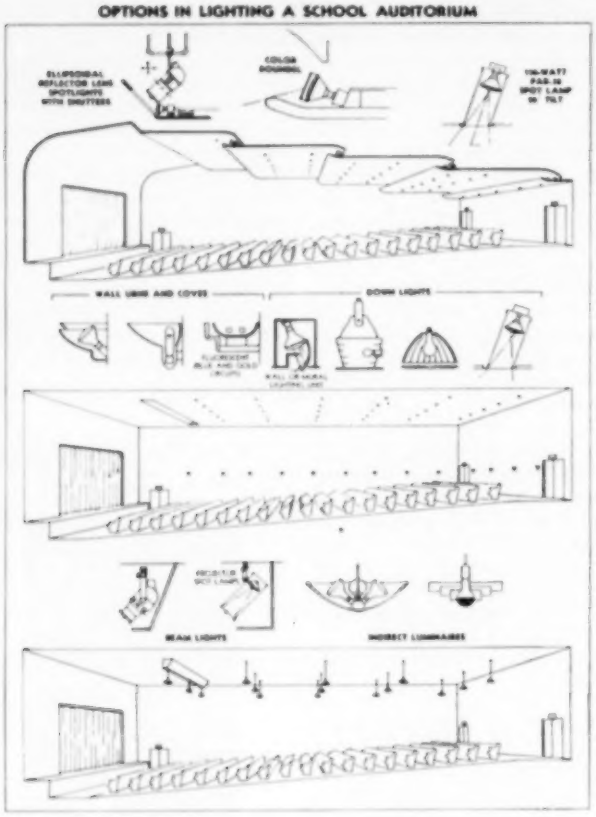


Figure 1.

a two-fold problem. First there is the need to provide environmental lighting which will produce an appropriate decorative atmosphere. Second there is the need to provide illumination over the seating area which will not be distracting even when used under darkened room conditions. To aid the architect and designer, Fig. 1 illustrates a range of ways of obtaining both types of lighting in a typical size school auditorium. One suggestion is based upon the noticeable trend in schools of step-back ceiling coves which offer possibilities for attractive atmosphere lighting and also acoustical benefits. As most existing schools will need to improve conditions with a minimum expenditure and structural change, the two other suggestions of Fig. 1 illustrate what may be accomplished under more limited conditions.

Too often, when a school is under construction the red pencil is used to strike out stage lighting equipment because of a tight budget. Too often, also, the equipment that may be left on the blueprints are only the footlights. By themselves these may be the least useful of any of the lighting equipment employed on the stage. In recognition of this condition a suggested relative rating for the various items of equipment as to their relative importance is offered: (1) first border spotlights, (2) first border striplights, (3) auditorium ceiling spotlights, (4) rear stage overhead floodlights, (5) supplementary portable equipment—spots, floods, striplights, (6) intermediate border striplights and spotlights, (7) side spotlights, (8) footlights. Items 1, 2, 3 and 4 represent the minimum initial equipment usually required. Thus, if the decision must be made as to what to omit, at least the equipment left will be that which is the most useful, and a plan remains as to the order in which the missing equipment may be acquired. A consideration of the visual requirements which limit an auditorium's size and seating capacity indicate that an auditorium 80 feet long and 60 feet wide with a 700 seating capacity is about maximum, if good seeing conditions are to be maintained for dramatic presentations of the scale usually given in schools.

A study of the relighting of a grade school auditorium with a limited budget indicates that reflector and projector lamps may be used throughout, as they provide a suitable degree of control, are convenient, and represent a low original cost.

Advances in Airport Lighting

W. A. Pennow

THIS study attempts to give engineers a better understanding of the special features of each of the three general types of high intensity runway lights. The direct comparison of typical units should minimize any tendency to misapply such lights.

The performance of medium intensity runway lights is described, and the wide gap existing between present high intensity and medium intensity runway lights is discussed.

Analyses are based on present required methods of operation of lights and present approach and landing procedures for airplanes, as related to photometric performance of lights.

The new Region of Guidance, that volume of space extending from the lights toward the approaching airplane, in which the airplane will be as a result of an instrument approach,

Author: Westinghouse Electric Corp., Cleveland, Ohio.

is described and data show the coverage by a typical unit of each of the three types of high intensity lights.

The paper points out the inadequacy of present lights for use in the not too distant future, and shows the need for a new class of intermediate intensity runway lights to bridge the gap between high intensity and medium intensity runway lights.

Recommendations are made for the development of new intermediate intensity lights for non-instrument runways at major terminal airports; for revision of photometric performance of wide beam high intensity runway lights, and for development of high intensity runway lights suitable for future use in very bad weather.

The inadequacy of taxiway lights even for present operation methods is pointed out, and the need for a completely new attack on this problem is stressed.

Effect of Task-to-Surround Brightness Ratios on Visual Performance

R. L. Biesele, Jr.

FOR some time, it has been apparent that the brightness ratio of the visual task to its surround had a definite effect on the comfort of persons doing moderately difficult visual work. It appeared desirable to investigate the possibility that this task-to-surround brightness ratio might also affect the performance rate of such a visual task. Consequently a grant was obtained from the I.E.S. Research Fund for a pilot study (Project #18) to investigate a method by which quantitative measurements of this effect might be obtained.

The general plan of the project has been to investigate the effect of various task-to-surround brightness ratios on the speed of marking the gaps in a set of Landolt rings. The test represents a performance task closely related to typical work situations. Several test procedures were tried.

In the first procedure, one-minute tests were run on subjects with eyes rested, with brightness ratios ranging from 1:1/20 to 1:10, with the task brightness constant at 20 footlamberts. No significant change in performance was found for any change in the brightness ratio of task to surround, for this test.

In the second test, the brightness ratio was held constant for one hour, and the rate of marking was checked at ten minute intervals. Contrary to expectation, the performance actually increased during the hour for each brightness ratio. Apparently the brightness ratios had no effect on the fatigue produced during the hour period, or the subjects were able to overcompensate for it.

In the third test, a four-hour fatigue test, fatigue is indicated by a reduced performance rate during the latter part of the test for the ratios 1:1/20, 1:1/10,. and 1:10. In addition, there is a significant variation in the average rate of performance for the four-hour tests for the different brightness ratios. The maximum rate was attained for the task-to-surround ratio 1:1/3. The rate was reduced to roughly seven-tenths maximum and one-half maximum at the ratios 1:1/20 and 1:10, respectively. Variations of this magnitude, if confirmed by additional tests, would mean that the task-to-surround brightness ratio is as important to visual performance as is the illumination level.

In the fourth test, a test with eyes rested, for one minute, with task-to-surround brightness ratio held at 1:1, but brightness of task varied from 1 to 100 footlamberts, the data from only one of three observers checked with accepted visual data.

Since the data for each test was limited to only a few observers, no definite conclusions can be drawn from the data. But the data obtained has raised certain questions in the mind of the author. First, how much reliance can be placed on visual data based on a limited number of subjects, or taken with rested eyes, or derived from visual tests of short duration? Second, is the task-to-surround brightness ratio as significant as the four-hour tests indicate? Third, if it is, should not the illuminating engineer be fully as concerned with this ratio as with the illumination level provided?

The tests indicate that this is a method by which significant data can be obtained. It is recommended that the project be continued and amplified.

Author: Southern Methodist University, Dallas, Texas.

Aircraft Lighting and Lighting Developments

W. C. Bryant

LIGHTING plays an essential role in the performance and safety of all modern aircraft, both military and commercial. To provide the necessary lighting for a large aircraft, some 30 to 35 different types of lamps are required with power consumptions ranging from 1.5 watts for the grain-of-wheat instrument lamps to 600 watts for the landing lights. Present Constellations require 400 to 500 separate lamps having a total wattage varying from 5 to 8 kilowatts. Except for a few ultraviolet and fluorescent, the lamps are of the incandescent variety.

The problem of cabin lighting in commercial, and to some extent in military, aircraft is quite similar to that of a modern deluxe railroad car or bus with a few additional disconcerting requirements, such as space and weight limitations. The levels of both general and supplementary illumination usually are kept rather low in contrast to commercial practice. The individ-

Author: Lockheed Aircraft Corp., Burbank, Calif.

ual reading light problem, whereby approximately 25 ft-c of illumination is provided for the normal reading area in front of each passenger in such a manner so as not to interfere with the wishes of other passengers, has now been solved through the splendid cooperation of several lighting equipment manufacturers.

Since 85 per cent of all knowledge is gained through the visual sense, it should be quite apparent that cockpit instrument and panel lighting is by far the most important application of lighting in an aircraft, and right up near the top of the list of those things that contribute to its safe and reliable operation. In no other known application, have the lighting problems been quite so comprehensive and complex. The problem is also accentuated by the increase of aircraft speed and all-weather around-the-clock flying. With the culmination of the past few years' work by many individual companies, however, we are now approaching solutions to these perplexing problems of instrument and control panel lighting.

Red lighting is being used almost exclusively for all cockpit illumination because it causes less distraction, is less fatiguing, and has little effect on the night adaptation of the eyes. The instrument-lighting problem is being solved (1) by the indirect lighting of the dials through lucite rings which form a part of the instrument and provide illumination without going through the cover glass and (2) by direct lighting with the use of individual instrument shields or shrouds that direct the light through the glass but only where it is needed and with a minimum of reflections and glare. It is fervently hoped, however, that some day the instrument manufacturers will concern themselves with the illumination of their instruments, for it is our feeling that the ultimate in instrument lighting can only come about by the development of methods for the entry of light from some direction other than through the cover glass and that this problem should rightly be solved by the instrument manufacturers.

After years of fumbling around in the dark, one-piece plastic red edge-lighted control panels appear to be the solution to most of the control-panel illumination problems. The procedure usually followed is to cover the top surface of a ⅛ plastic panel with a translucent white paint which is then covered with a negative black print so that the lettering and markings show up white and the remainder of the panel black. The desired results have been obtained by such processes as paper prints, photo-etching special decalcomanias, and silk screening. When viewed in the daytime, the lettering appears white and, of course, when edge-lighted at night with red filtered front mounted lamps, the lettering appears red.

Many details still remain before optimum instrument and panel lighting is completely achieved for aircraft, but with the developments now taking place, it is believed safe to conclude that the often heard question — "Why is it that a low-priced automobile has better lighting than a high-priced aircraft?" will never be heard again.

In the realm of exterior lighting for aircraft, the problem is also complex, and unfortunately there is hardly a perceptible interest in its improvement. This phase of the aircraft lighting problem has always been confused by the fact that more has been expected of the lighting than could conceivably be achieved. In this sense it could be termed a misapplication. However, it is possible to achieve optimum results, within practical aircraft limitations, if lighting engineers become conversant with the many facets of the problem and direct their recommendations and efforts towards its resolution.

Approach Light Testing at Landing Aids Experiment Station, Arcata, California

H. J. Cory Pearson

DURING the past few years a great deal of study has been given to approach lighting and other landing aids. For the past four years, Transocean Airlines, under a contract with the Civil Aeronautics Administration, has operated the Landing Aids Experiment Station at Arcata, California. This contractor, under the technical direction of the Air Force-Navy-Civil Subcommittee on Visual Aids to Air Navigation, has carried on an intensive program of flight-testing of various types and arrangements of approach lights.

The airport was equipped with the USAF Instrument Low Approach System (ILAS) and Ground Control Approach System (GCA). Either electronic aid could be used by the pilot, with the other available for use as a monitor. The electronic aids also furnished a convenient means of recording the path of the aircraft during tests.

Ceilings and visibilities were measured and recorded with ceilometers and transmissometers. One ceilometer was located near the touchdown zone and another near the end of the approach zone. Six transmissometers were located at various points on the airport.

Flight tests were made at any time the ceiling or visibility was less than 100 feet and one-half mile respectively. During the approach the co-pilot watched for the lights while the pilot flew "on instruments." The co-pilot called out when the lights were sighted. As soon as enough lights were in sight, the pilot would attempt to complete the approach and landing by following the light pattern. In order for an approach to be successful, the pilot had to complete the landing with only

Author: Chief, Lighting Branch, Airport Div., C.A.A., Indianapolis, Ind.

such reference to instruments that he would make in a normal landing in clear weather. All conversations during the approach and landing were recorded. In most cases motion pictures were made of the lights as they appeared from the cockpit during the test.

During the period that the station was in operation, practically all proposed approach light systems were tested. However, operation of the station was discontinued before it was possible to make complete tests on the system developed by Mr. E. S. Calvert and on the system sponsored by the Air Line Pilots' Association.

The final results established that the slope line system is superior to all systems adequately tested, and gave strong indications that it is superior to any system that has been proposed.

The "X" Factors in Fluorescent Lighting

B. S. Benson, Jr. Eric H. Church

OCCASIONALLY the lighting application engineer in the field runs into a fluorescent lighting installation where the actual initial (at 100 hours of burning) illumination is considerably at odds with that which he computed. Though he probably checked his calculations before making his recommendations he goes back and rechecks them once again — no mistakes in addition, none in subtraction, none in multiplication or division, no misplaced decimal point ... no mistakes at all! Yet the fact remains that actual and calculated values are appreciably at variance! Why? The answer is probably due to what the authors have chosen to call "X" factors.

The "X" factors represent all of those elements which tend to derail the expected train of events between *calculated* initial and *actual* initial levels of illumination.

The object of this paper is to enumerate some of these "X" factors and to report on the effects certain of them may have on the amount of illumination received at the plane of work. Included in the discussion are the following:

1. Variations in the performance of individual lamps.
2. Variations in the performance of individual ballasts.
3. Variations in the performance of individual luminaires.
4. Ambient temperature.
5. Drafts.
6. Line voltage.
7. Atmospheric absorption.
8. Lighting calculation data.

Tests were conducted in a 150-inch integrating sphere and in a heat-cold chamber to investigate the effects of those "X" factors dealing with line voltage, temperature, individual lamps and individual ballasts in their association with industrial type luminaires.

From the casual samplings of lamps and ballasts were discovered variations both large and small which, either singly or in their cumulative effect upon the light output, might well result in considerable differences between actual and calculated initial illumination values.

Authors: Benjamin Electric Mfg. Co., Des Plaines, Ill.

A study of the lighting calculation methods now published and in general use today points out how additional differences may result through the unadvised use of the present room-index tables.

The investigation undertaken points out the following needs:

1. A standardization of performance (consistent with quality) of ballast equipment.
2. Photometric tests of luminaires based on the light output of the lamp-ballast-luminaire combination rather than on the assumption that the lamp-ballast combination is delivering rated lumens.
3. The development, when possible, of fluorescent lamps that will deliver peak light output higher on the temperature scale.
4. Further study of the combined effects of temperature and line voltage on the light output of the actual lamp-ballast-luminaire combinations so that correcting factors can be applied where required in lighting calculations.
5. Greater refinements in the "lumen method" of calculations — particularly in the room-index tables.

Measurement of Visibility

C. L. Cottrell

VISIBILITY is considered as a component factor of a seeing task. The definition and measurement of visibility in terms of previously described methods are briefly reviewed.

An instrument called the contrast-brightness threshold meter is described. It consists of a modified type of visibility meter introduced by Dr. L. A. Jones of the Eastman Kodak Company for use in testing the effectiveness of ship camouflage in 1918. The new instrument, shown in the accompanying illustration, makes use of a form of gun-sight arranged to project a luminous area upon the visual task. The brightness of this area is made

Author: Cornell University, Ithaca, N. Y.

Contrast-brightness threshold meter.

equal to that of the background of the task. Then to reduce the visual target to threshold, a neutral gradient filter in front of the instrument is adjusted to determine the brightness-contrast threshold of the target. The transmission factor of the filter for this setting determines numerically an index of the contrast threshold of the visual target under the particular illumination in use. For lower values of illumination, measurements may be made by the observer affixing neutral filter spectacles of known transmissions and repeating the observations. From these data a curve of brightness-contrast threshold versus brightness of background may be obtained for visual tasks.

The Luckiesh-Moss meter was also used to determine the relation of its calibrated "relative visibility" measurements over a range of background brightnesses for the same targets observed by use of the contrast-brightness threshold meter.

The targets used consisted of several types of test objects including the Landolt ring, the "standard" parallel-bar test object, parallel stripes of equal width and spacing and extending over a five-degree field, 8-point Bodoni type, typewritten o and e groups, and two low-contrast split fields. The first three objects mentioned were each used in a range of sizes with a maximum detail size of ten minutes of arc.

Observations were made with an extended surround of the same brightness as that of the target background. The contrast-brightness threshold meter was first constructed for binocular use, for better comparison with the binocular L-M meter. Later, with equal adaptation for both eyes, monocular use of the c-b threshold meter checked the results obtained when the meter was used binocularly.

The threshold curves obtained by each instrument show an interesting relationship to the performance data of Weston on the Landolt ring test object. The constant "speed of performance" curves of Weston for contrast versus brightness are essentially parallel to the threshold curves obtained by use of c-b threshold meter. This may lead to effective use of the c-b threshold curve of a visual test object, for prescribing a desirable level of illumination for that particular test object.

Some advantages for the particular c-b threshold meter described here are: (1) results of its measurements are presented in terms of a single physical property, (2) eye conditions are not greatly affected in adaptation or accommodation during use of the meter, (3) high-lights in the field of view are less effective in producing a veiling glare due to the non-scattering property of the gradient filter, and (4) a facility exists for obtaining enough points on the contrast-brightness threshold curve to determine its character, making the observations directly "on the job."

Daylight in Classrooms — Multilateral Lighting

R. L. Biesele, Jr.

THIS paper is the second covering an extensive study of daylighting design techniques for classrooms. The purpose of the studies, which have extended over a period of three years, has been to determine the practical techniques which are available for producing beneficial visual environments in classrooms, using daylight as the primary light source. The previous paper, "Daylight in Classrooms," was published in the July, 1950 issue of ILLUMINATING ENGINEERING. It covered arrangements employing windows in only one wall, or so-called "unilateral" lighting.

The present paper presents data obtained in a study of daylighting arrangements with windows in more than one wall, the so-called "bilateral" and "multilateral" arrangements. The most extensive use of such designs has been made in California, and the studies reported in the paper were preceded by an extensive field survey of the newer California schools during the summer of 1949.

Variation among the designs in California is quite wide, but the majority of them can be classified as variants of one or the other of two basic types:

Type 1 — Bilateral. This type employs a room 32 feet square with the main window running from sill to ceiling the full length of the north wall, with an auxiliary window running the full length of the south wall, usually above the roof of an outside corridor.

Type 2 — Clerestory or Monitor. This type employs a room also 32 feet square, with the main window running the length of the north wall, and with an auxiliary window also facing north and running the length of a clerestory or monitor section set into the roof at about one third the distance from the north to the south wall.

Author: Southern Methodist University, Dallas, Texas.

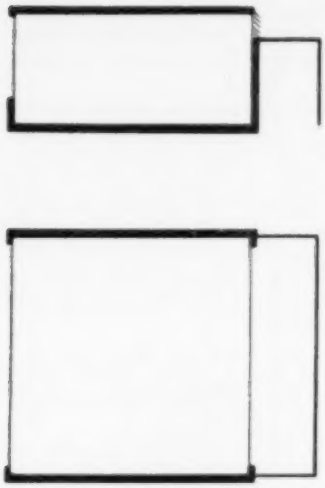


Figure 1. Typical bilateral classroom lighting design.

Both these types are covered by the tests, which have been reported for various daylight conditions, with control devices as needed.

Illumination levels exceeding 30 footcandles minimum at any point in the room were obtained for a wide range of exterior daylight conditions. The average illumination for most of the tests either approached or exceeded 100 footcandles, with daylight alone. It was found to be as high as 431 footcandles average on one test, which incidentally was for an overcast sky.

Brightness ratios in general met or approached the recommendations of the American Standard Practice for School Lighting. The bilateral design was somewhat less effective in this regard than was the clerestory design, or the unilateral designs previously reported. In every case, however, the brightness ratios were highly satisfactory for the "heads down," or working position.

The tests have indicated that, with careful correlation of fenestration, light controls, decoration, and seating, daylighting designs meeting all the recommendations as to quality and quantity of illumination contained in the American Standard Practice for School Lighting can be readily attained, even for classrooms 32 feet wide.

Electroluminescence—A New Method of Producing Light

Eric L. Mager Elmer C. Payne

WHEN certain materials are placed in a varying electric field under proper conditions, they are excited to luminescence and continue to emit light as long as the exciting field is maintained. This constitutes the phenomenon of *electroluminescence*, and is a new approach to the problem of "cold light." No intermediate phenomenon such as a glow or arc discharge appears to be involved. The materials appear to luminesce directly under the influence of the changing electric field. Since this seems to be a direct transformation of electrical energy into light it offers intriguing new possibilities.

A clock whose face is a luminescent (condenser) lamp.

A simple device for the study of electroluminescence consists essentially of a layer of phosphor dispersed in a dielectric and placed between two conducting plates. At least one of these plates should be transparent in order for the light generated to be available for use. Such a device is obviously a capacitor. In this instance it is a *luminous* capacitor.

A number of substances have been found which can be excited to a greater or lesser degree in this manner. Some are also fluorescent under ultraviolet or cathode ray excitation, some are phosphorescent, and some are neither. No direct correlation has been observed between the luminescence of a phosphor excited by the electric field and that resulting from ultraviolet or cathode ray excitation. Those materials which emit light in sufficient intensity to be of practical interest are extremely specialized.

In studying these devices, simultaneous cathode ray tube graphs were taken of the applied voltage, the current, and the light emitted, making it possible to determine the phase relationships of these variables. Luminescence occurs only when the potential is changing, and most of the lumines-

Authors: Sylvania Electric Products Inc., Salem, Mass.

cence occurs when both voltage and current are in the same direction although in different quadrants. This is the period when the capacitor is absorbing energy. In other words, the light emission in the lamp described is in phase with the positive half of the power curve of the luminous capacitor. Other data show that the luminosity is a function of frequency.

The characteristics of this new light source are ideal for its use as a luminous ceiling where the lamps are mounted much in the fashion of acoustic tile and a broad, uniform low-brightness source of illumination is obtained. Many other practical applications are possible. Some of them such as luminous dials, luminous switch plates and similar applications have been made up. The accompanying illustration is a photograph of a clock whose face is a luminescent (condenser) lamp.

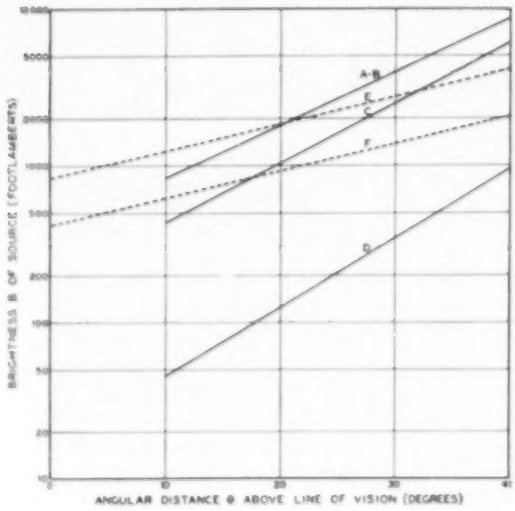
Comfortable Brightness Relationships for Critical and Casual Seeing

Sylvester K. Guth

THE goal of the art and science of illuminating engineering is to provide in visual environments a proper balance of certain controllable factors which influence human performance and comfort. In general, these factors may be combined into the single element of brightness, and thus brightness engineering has become an overwhelmingly important aspect of the more inclusive field of illuminating engineering. Since seeing is a dynamic activity of human beings, any concept of the evaluation of brightnesses in the visual field should take cognizance of a variable line of visual fixation and of the work-world demands of a critical visual task.

In the first part of this paper are summarized the results of a series of investigations involving the evaluation of sources of brightness by a representative group of observers while performing a task of critical seeing. The criteria included the sensation of brightness which was (1) at the borderline between comfort and discomfort (BCD) and (2) just barely distracting. Momentary and prolonged exposures of the sources were included. The results indicate that there is no significant difference between the observed BCD brightnesses determined with the two methods of exposing the sources. However, when the criterion is distraction, a source that is momentarily exposed must be reduced to about one-tenth the brightness of a source that is exposed continuously. Similarly, for a source to be just barely distracting (prolonged exposure), its brightness must be reduced to approximately 60 per cent of the BCD brightness.

The second part of the paper is a summary of an investigation which relates the basic BCD relationships to actual lighting practice. Evaluation of brightnesses at the borderline between comfort and discomfort were made of fluorescent lighting in a simulated visual environment. The experimental variables included the brightness, area, location and the number of luminous elements which were exposed. Observed values of average



The relationships between brightnesses B and the angular displacement θ sources above the line of vision for BCD and barely distracting sensations when the observers were performing a task of critical seeing. The solid lines represent the observed data for the average BCD sensation for both continuous and momentary exposure of sources, A-B, and the distraction sensation for continuous, C, and momentary, D, exposure of sources. The broken lines E and F represent the average and lower limits of BCD brightness, respectively, for casual seeing.

Author: General Electric Co., Nela Park, Cleveland, Ohio.

BCD brightnesses were compared with values calculated from the empirical equation developed from the basic data:

$$B = MPF^{0.44}(Q^{-0.21} - 1.28)$$

In this equation, the BCD brightness B of a source is expressed in terms of its size Q, its position index P, the adaptation brightness F, and an index of sensation M. The close agreement found between the observed and calculated BCD brightnesses indicate that the appraisal of the visual comfort or discomfort of lighting installations involves simple determinations of the size, brightness and position index of its luminous elements or areas.

Uniformity of Illumination in Highway Lighting

D. M. Finch

A. E. Simmons

IT IS suggested that the design procedures used in highway lighting should be reviewed because of changes that have occurred in light sources and fixture design within the last few years. Many state highway departments and local government agencies are engaged in an expanded program of safety lighting and many discussions are prevalent in these agencies regarding the best method of design.

The purpose of the paper is to review the design procedures and analyze them in terms of the recognized quantities associated with a good lighting design, namely, adequate pavement brightness with good uniformity together with reasonable freedom from glare. Since the glare problem is separate and distinct and is being reviewed in another paper it has been deleted from consideration in this paper although it is recognized as being of prime importance. A technique of lighting layout which will permit a "figure of merit" to be assessed to each layout is highly desirable and has been developed.

In most cases a design engineer cannot spend the time required to use all of the basic data available in making his layout. It would seem desirable to have a simple method whereby the designer could quickly get all essential design information for a given arrangement of lighting units, mounting height and roadway width. The necessary information includes:

1. minimum illumination
2. maximum illumination
3. average illumination
4. ratio of maximum to minimum illumination
5. spacing to use for any required illumination and lamp size

It is believed that uniformity of illumination is of primary concern in any good highway-lighting layout because it affects the pattern of pavement brightness as seen by motorists. Using such typical data as shown in Fig. 3, a designer can immediately pick off the spacing and lamp size required for any set of roadway illumination conditions. It is suggested that luminaire manufacturers consider such a method of presentation of data in order to eliminate repetitious types of computations by field engineers. A review of several typical installations shows that when the Recommended Practice procedures are used, wide variations in roadway illumination and brightness patterns may result even though the average illumination is maintained constant. It is suggested that the roadway illumination be held substantially constant with a maximum ratio of illumination in the order of 4 to 1. It is further suggested that the minimum illumination in the roadway area should be used as a design criterion rather than the average value. This would assure an adequate minimum value on all points on the roadway and would tend to eliminate the large crests and troughs in the distribution of illumination along the roadway that prevail in many instances. The latter are considered highly undesirable because of the camouflage type of pattern that is introduced.

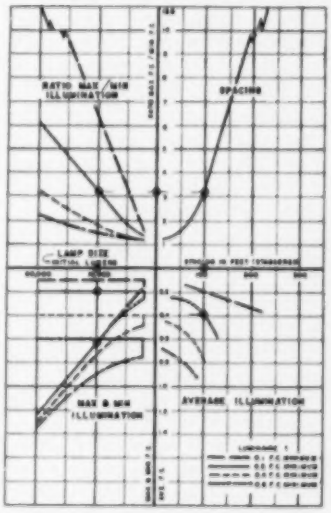


Figure 3. Luminaire performance curves. Mounting height 30 feet. Roadway width 102 feet. A.S.A. Type IV, Minimum illumination method.

Authors: University of California, Berkeley, and Div. of Highways, State of California, respectively.

Muscle Action Potentials as Related to Visual Tasks in Industry

Willard Allphin

Operator soldering wires in starter sockets.

THE effects of illumination level on acuity, speed of vision, and productivity are well known, but there is need for a method of measuring the physiological cost of seeing; that is, whatever we "use up" within our bodies when we see. Several researchers have become interested in muscle-action potentials as a possible criterion, and I.E.S. Research Project No. 23, conducted at Tufts College, made a preliminary exploration of the tiny voltages generated in the frontalis muscles when reading.

The Tufts study was not carried far enough to be conclusive, but it did hold promise for further profitable work. The present paper reports measurements made on three tasks in industry, using portable devices to measure muscle-action potentials:

1. A secretary typing from shorthand and typescript showed no significant difference in tension level between high illumination and low, but it was not feasible to measure her work rate, and it is possible that she was working faster under the higher illumination.

2. An operator feeding fine filament wires into a lamp-working machine showed no significant difference in tension level between high and low illumination, but the speed of the machine was fixed and it is possible that the job made only slight demands on her visual capacities.

3. An operator assembling fluorescent starter sockets showed peaks of tension level at the moment of soldering, when most critical seeing was demanded. These peaks were substantially higher under three footcandles than under 68 footcandles of illumination. Furthermore, the average time of assembly was 15 per cent longer under the low illumination.

Really quantitative work will have to be performed in the laboratory because of the difficulty of controlling conditions in a factory without interfering with production, but this brief excursion into industry indicates that there is further promise for associating muscle-action potentials with the physiological cost of seeing.

Among the many other investigations which need to be made are the study of optimum illumination levels for various industrial tasks and the effect of position and magnitude of a glare source in the field of view. Besides supplying useful data, such work will tend to further confirm or disprove the criterion.

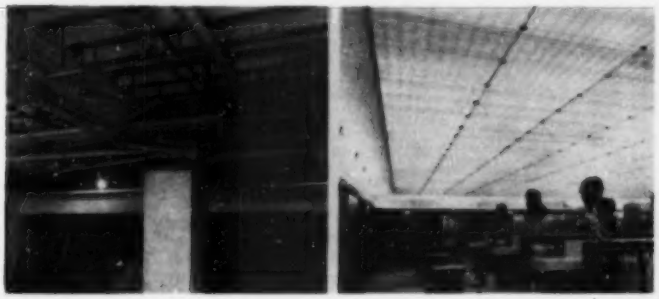
Author: Sylvania Electric Products Inc., Ipswich, Mass.

Experience Studies of Louverall Ceilings in Department Stores

NEW concepts of living are reflected constantly in the design of everything around us. In the past years, buildings and interiors have undergone a distinct evolution indicative of the era of design. Today, many buildings are considered and designed for a useful, specific lifetime of from 10 to 20 years. The general use of lath and plaster for ceilings and walls was the first component of the integrated structure to feel the impact of the change

Robert R. Wylie

Author: Sylvania Electric Products Inc., New York, N. Y.



"Before" and "after" view of a typical ceiling in a department store, showing utility piping and services present and to be hidden in some fashion for modern retailing.

towards prefabricated building components and prepackaged building components.

Naturally, these trends have brought forth the necessity for a parallel development in lighting. Until very recently, lighting design was as inflexible as was the possibility of universal utilization of space within the walls of the older buildings. The introduction of the louvered ceiling immediately made apparent a new concept in lighting flexibility. This new "module" became an important tool in effecting savings in the lighting of merchandising interiors. Typical apparent savings are:

1. Savings which were made in air-conditioning diffuser equipment by the use of louvered ceilings.

2. Savings can be realized in sprinkler treatment by the use of louvered ceilings.

3. Savings in maintenance costs become obvious when one considers that the conventional ceiling requires washing or painting every year and a half.

4. Certain intangible, but important, savings can be realized because of the nature of the louvered ceiling. Since the entire ceiling is dry-type construction, there is no need for expensive precautionary measures such as the removal of merchandise from large areas, nor for the erection and dismantling of costly barricades while the modular ceiling is being installed or changed. Dry-type construction means an earlier completion date. Time-saving installation of the louvered ceiling supports can be accomplished concurrently with the installation of other utilities which are placed on the ceiling. The repainting which usually accompanies renovations is eliminated. Wiring, which usually has to be concealed, can be run exposed on the subceiling to feed the simplest, most efficient, lowest cost lighting fixtures above the louvered ceiling.

5. By adroit planning and operation of the louvered ceiling lighting system, operating costs may be reduced.

6. Unlike conventional system usage, louvered ceilings permit the merchant to place the sales accent where it is wanted, when it is wanted, at minimum sales expense and store overhead.

7. Louvered ceilings permit a constant change within a store to keep abreast of competition.

8. Pattern can be introduced into the ceiling by the use of modular ceiling panels other than the louvers. A non-luminous module consisting of alternately inverted rows of slats (similar in dimension and shape to venetian blind slats) securely fastened at each end has been designed to form a pattern building module for those areas where obstructions, such as air-conditioning ducts, reduce the head room available for mounting fixtures above a louvered ceiling. A luminous module consisting of a corrugated plastic panel bounded by a metal retaining frame has been developed for use where reflected brightness, which may impair seeing, is encountered.

The details of planning a louvered ceiling installation consist of three components, (1) the room or space into which it is installed, (2) the louver grid, and (3) the lighting units above the grid. The relationship between the grid and fixtures, between the fixtures, and the height of the grid above the floor must be established. The three relationships determine the appearance of the louver grid (that is, whether it is evenly or unevenly lighted), the intensity of illumination provided on the working level, and the headroom in the finished room. In most installations, the arrangement of fixture rows will be parallel to the axis of the grid. However, where evenly lighted ceilings are desired, the best grid appearance is obtained when the fixtures are arranged diagonally to the axis.

"Proceedings" Issue

A limited quantity of complete sets of all of the 1950 Conference papers in full, in one cover-bound volume, will be available from the Publications Office of I.E.S. Headquarters, as a "Proceedings" issue of the 1950 National Technical Conference. Price is $2.00 per set. Not all of the Conference papers are at present scheduled for publication in full in ILLUMINATING ENGINEERING, the Proceedings issue being made available for reference on the complete program.

The President's Annual Address

By CHARLES H. GODDARD

President

THE REPORT of our General Secretary,* will give you a rather complete picture of the Society's activities during this fiscal year. It is a picture of progress and development which reflects the sincere, hard work of the I.E.S. Council, national officers, Sections and Chapters, and the national committees. Do not for one moment, however, consider these splendid results as having been produced entirely by this administration. Many of our activities were initiated previously and have been nurtured by conscientious members over the past several years. It is just my good fortune that some of these projects have come to fruition during my Presidency. Although time does not permit reiterating all the details, it is evident that this has been another productive year for I.E.S. Our more valuable progress has come from consolidating and refining our gains.

Including the trip to Pasadena, I will have traveled this past year, just about 40,000 miles. From February 1 to June 1, I was in my business office just eight days. Now, I do not recite this to elicit sympathy, since I look upon this year as one full of gratifying experiences, a year in which I was privileged to work closely with our membership over this entire continent. It has been a year that, I trust, has made some contribution to the future welfare of the Illuminating Engineering Society.

When we consider the Society's continued growth and the increasing demands that are made of a President, we must realize that there is a practical limit which we cannot exceed. With this in mind, I recommend that we coordinate the dates of Regional Conferences so that the President can attend all of these valuable meetings. Their dates should not conflict one with the other. They should be scheduled so that he may travel to all of them without "back-tracking." This year I regretted missing one of our Regional Conferences completely because it was finally scheduled for the exact days of another conference 1,000 miles away. It would also seem advisable that Regional Conference dates be determined possibly two years in advance so that such a coordinated schedule could be continuously maintained. The Regional Vice-President, of course, would meet with the Sections and Chapters at least once a year and, where possible, twice each year. In this way, a continuous exchange of thought and inspiration can be kept flowing back and forth.

Last year, when discussing our 1950 objectives at the French Lick Conference, I outlined the work of our Regional Vice-Presidents. It is a genuine pleasure to report to you that these men have turned in a magnificent record of achievement and, thanks to their constant attention, the Society has exceptionally strong roots in every corner of these United States and the Provinces of Canada. Naturally, none of this would have been possible without the basic ground-work done by the members locally, and to these folks goes my unqualified congratulations.

All of this falls under the heading of Local Activities which has brought three new chapters into existence this year. Behind each new chapter you will always find the hard work of a local representative. These new chapters will need help and it is desirable that the Society, locally and nationally, always work closely with them. We must make sure they have good program material, especially good speakers. The Regional Vice-President should stay close to this situation, with full support from Headquarters.

Substance of an Address given before the National Technical Conference of the Illuminating Engineering Society, August 21, 1950, Pasadena, California, by the President of the Society.

*To be published in full in a later issue.

While we are on the subject of Local Activities, I wish all our Chapters and Sections would consider the advisability of electing two Board Members for a two-year term and two Members for a one-year term. After the first year, there would be an automatic carry-over of at least one-half the Board with a full year's experience. Such a procedure might be considered next year.

You should know how we stand financially. We started the year with the largest financial budget ever approved by Council. It showed a large expense and a large income. We should be proud of our Finance Committee and the Treasurer since our program has gone through on schedule, with nothing curtailed and nothing deleted. We have paid our bills promptly and will end up the year a little ahead—not much, but definitely in the black. We are planning to publish a new revised Handbook, which is progressing nicely but which will require sizable financial commitments. This we must accept, since the publication of a handbook on lighting is surely our obligation and I am positive it will be another successful venture. In the doing, however, can we not arrange for this valuable contribution in knowledge and practice to make an equally valuable contribution to our reserve in the bank? Our financial program is of such magnitude that we cannot relax for one moment. This will be particularly true as we go into the future. It is not my intention to discuss war or the economics related to the preparations for war, but it is my duty to alert our membership to the changes ahead and the need for operating plans which are flexible; plans which are in tune with the needs of changing industry conditions and, Armed Services requirements; plus the very definite need of controlling our finances so that full continuity is maintained throughout the field of our endeavor. Right now, we have enough money in reserve to run our Society about two months. It seems to me we would be wise to build our reserves to about five times this ratio and we should accomplish this increase within the next five years.

I know you will be pleased to learn that your Society is in a much better position to assist the government and the Armed Forces than we were when we were attacked at Pearl Harbor. As you know, we have always helped as best we could in any crisis facing our government. For many months now, we have been in direct contact with the Army and Navy and are working closely on several important projects — in fact, I think it is fair to say that our government at this time fully recognizes that in this country and in Canada, the Illuminating Engineering Society is the official organization to consult on any matter pertaining to illumination.

One of the objectives I had set for myself this year was to coordinate the work of our national officers in such a way that there would be a minimum of duplication of effort and a maximum of effective operation. The Illuminating Engineering Society has grown into a pretty sizable business, international in scope, and is beset with all the problems inherent with such an operation. No one could ask for closer cooperation than has been evidenced by your national officers. Each took his responsibilities seriously and dispatched all obligations expediently.

We have referred to the splendid work of our Treasurer and our Vice-President in charge of Local Activities. By the nature of his report* you should know how very attentive our General Secretary has been. I can assure you that he has worked diligently this year. Our Vice-President in charge of Technical Committees has not only turned in a fine record but has always been on hand to help me in the execution of my responsibilities.

We have a fine group of officers. We need them to carry forward the operations of our Society, but our most comprehensive results are obtained when these officers sit down with our directors and meet as your Council. The Illuminating Engineering Society is blessed with an abundance of talent on its Council — men and women who have had years of experience in the operation of the Society, locally and internationally, as well as having responsible positions in the business and professional world. Now, I wonder if we are making the most of this superb talent. During the past several years, Council meetings have been held once every two months, and there has been a recent trend to accomplish its work within one day, even if that day sometimes becomes an exceedingly long one. I have no argument with this arrangement since we surely want to conserve the time of our Council members—but I have been greatly concerned about the utilization of our efforts when we are together at Council meeting. Our Constitution and By-Laws require innumerable items to be reviewed and approved by Council. This may be all in good order but if you will consider the list of such items always contained in our Council agenda you will realize that a sizable portion of the time of Council goes into approving action already taken by well qualified committees. Council must also investigate operating details which could very well be delegated to other proper authorities. It is my recommendation, therefore, that the agenda be

*To be published in a forthcoming issue.

Continued on page 567

Our Society in 1950-51

By WALTER STURROCK

President-Elect

AS WE stand at the beginning of the 46th year of the I.E.S. we can look backward with pride and look forward with enthusiasm and confidence. There has never been a time in the history of the Society when it has been involved in a greater number of separate but associated activities. These activities range all the way from highly scientific fundamental researches to the solving of lighting application problems. Although the general objectives of the Society do not change from year to year, each new administration is always confronted with new problems resulting from membership needs, light and lighting information demands, and changed conditions. Of particular importance for next year is the development of a better understanding among our membership of the value of the Society's program and of the responsibility of members for supporting it. Seven thousand men and women are today participating in the advancements of lighting through membership in the I.E.S. This number is only slightly greater than a year ago in spite of the fact that over 1100 new applications for membership were accepted during the year. The answer, of course, is evident—nearly 900 members resigned or were dropped due to a lack of interest, most of them being in the associate member group. The records show that, in general, they were members of only two or three years' standing.

Moreover, it is significant to note that during the last eight years when the total membership has doubled (3,341 to 7,000) nearly 6,800 applications were approved while about half this number were dropped or resigned. It has been estimated that there are at least 10,000 people, 3,000 of whom are not now on our membership list, who have responsibilities and opportunities in connection with lighting and who could profit greatly by a better understanding of their problems as acquired through membership in the Society. A goal of ten thousand members is, therefore, our objective, but along with it we must establish a long-range program to maintain membership interest over a period of years and thereby reduce the number of annual resignations. A study of this will be made during the next year. Perhaps a change is needed in the classification of member grades, or the dues paid, or a change in the balance between overall income, research activities, and services to the membership.

Our monthly journal, ILLUMINATING ENGINEERING, is now well established. Its pages must necessarily be devoted to timely articles on current lighting practices and developments, technical papers, committee reports and lighting news items reflecting the interests of its varied readership. In order to do this, the editor will find it impracticable from time to time to print in full some of the Technical Conference papers, Committee reports and Recommended Practices of Lighting. If material of this kind is needed in unabridged form it now appears that the cost of producing it will have to be handled from a special budget which will be self-liquidating from the sale of printed copies. Both the Publication Committee and the Finance Committee will continue during the coming year to study the printing and distribution problems involved, and implement a more satisfactory program for publishing Transactions; that is, maintaining a permanent record of the progress of the Science and Art of Lighting.

Substance of an Address given before the National Technical Conference of the Illuminating Engineering Society, August 21, 1950, at Pasadena, California.

As you all know, the Illuminating Engineering Society, like other well organized groups, operates each year under a budget for income and expenses which is studied and planned by the Finance Committee and adopted by Council. To supplement this budget the Constitution and By-Laws (Article 7, Section 11) states that "To provide for security and continued operations of Society activities, it shall be the aim and policy of the Society to develop and maintain a minimum reserve equal to twenty-five per cent of current total budgeted annual expenses." During the past few years the annual expenses have doubled, due not only to the higher price level and increased membership but also because of expanded activities, particularly in our Technical Director's staff and in our Publications program. On the other hand, the Reserve Funds has not been materially increased. Moreover, it is imperative that this reserve include adequate funds to meet the requirements of an employees' retirement plan. Reserve funds, and retirement funds, will continue during the coming year to get as much attention as possible.

The effective work of the I.E.S., however, is something more than organization, it is the work of the many committees. Much could be said about their plans and activities for next year but for timely interest I will mention only one of them, the Coordinating Committee for Defense. This committee represents one of those which has been very active and will, I am sure, continue so. Its surveys, contacts and recommendations are made in cooperation with the various Government agencies concerned with national security. The committee is now sponsoring a lighting project of wartime import, the details of which are not for publication.

The acceptance of a technology of light and lighting, to which our technical committees have contributed a great deal, is spreading rapidly in the Engineering colleges throughout the country. A recent review of the curriculums for seventy-one of them indicated that 47 colleges now offer illuminating engineering courses giving two hours or more of credit. It is of interest to find that 21 of the 47 colleges require all the electrical engineering undergraduates to take the illumination course; the work in the other colleges is elective. A total of 1950 students were enrolled in these courses in April of this year. The increased enrollment from year to year has inspired the formation of I.E.S. student branches which the Society has chartered and which it will continue to support. Many colleges and universities are actively engaged in fundamental researches in light, vision and seeing. A recent survey indicated that 102 projects are now being carried on by 44 educational institutions. Twelve of these projects are under the sponsorship of the I.E.S. Research Fund. All of them will continue to attract our attention.

In closing it seems appropriate to pay tribute to the California Institute of Technology for its 200-inch Hale telescope at the Palomar Mountain Observatory. This telescope has a larger light gathering capacity than any similar instrument and therefore permits the taking of better photographs. It has no lenses, only a large mirror and several auxiliary ones, which collect the light and bring it to a focal point either on or off the telescope as desired. So it is with your Society and its many active committees, all contributing their bit through a focal point for the advancement of our profession. This is our objective.

Annual Address—Goddard

Continued from page 565

made available to members of Council one week before the meeting, accompanied by sufficient supporting data to permit adequate review and subsequent conclusions. When Council meets, all routine matters can then be voted upon at one time. This suggested procedure concurs with the Constitution and would reduce to a minimum the time spent on recurring routine items. Furthermore, I recommend that we devote more of Council's thinking to problems of a long haul nature . . . problems of procedure within the Society and the relation of such procedures to our position in the lighting world — problems concerning our policies today and what they should be tomorrow — future planning, if you will. A summary of my feelings would indicate the need of more emphasis by Council in the guidance of overall Society affairs and more emphasis by the Executive Committee in translating such guidance into effective operation.

These recommendations would be more difficult to accept if it were not for our most competent headquarters staff. Their devotion and unstinting service assures the success of any worthy program and we can always rely upon our staff to adjust itself to whatever action seems best for the Society.

There is one other item on which I would like to comment. That is the matter of changing the dates of the Society's fiscal year. This subject has been discussed for some time, and a special Task Committee has been working on it all this year. However, no final conclusions have been reached.

As it now stands, with our fiscal year running from October to October, there is a period from May until September when an administration is neither "lumen nor lambert." New national and local officers and committees are being set up for the following year; yet there is an existing organization obligated to carry on. This seems to me most confusing and wasteful. I believe we should establish the fiscal year from July 1 to July 1. There are some objections to this but most of them resolve into the question — "when will we hold the National Conference?" Well, I say hold it whenever it seems best — February, June or September — and that Conference will be for the incoming President. The fiscal year, it seems to me, should coincide with the time when the change of administration responsibility actually takes place. My plan would have the incoming President start taking control right after the June Council meeting. He would then have all the summer months to get his organization lined up and thoroughly integrated. His first Council Meeting would be in October and he would carry right through to the next June Council meeting. With such a schedule, all the basic work of our national and local activities can be coordinated properly with line authority existent as needed. All other Society affairs and functions could fit in accordingly — in fact, they can be treated as incidental to the dates of the fiscal year.

I am grateful for the assistance given me by our official family and for the support given me by all the members. I want to pay tribute to our host, the Southern California Section, especially to the committees and West Coast members who have made this wonderful Conference program possible. I am especially grateful for the honor of serving as your President — a privilege which I shall always cherish.

Hillman's Pure Food Store, Chicago

A fluorescent fixture of a type usually found in schools has been selected to illuminate this up-to-date chain store — effectively and pleasantly. The fixtures, each containing two 40-watt lamps, are on 10-foot centers suspended from a 14-foot ceiling yielding 50 footcandles throughout. In addition, recessed spots have been employed over the meat counters. Photo and information supplied by Robert Ligare, Chicago Lighting Institute.

Lighting a Dining Room

THE LIGHTING OBJECTIVE: To provide general illumination for dining, supplementary and background lighting when candles are used, and to light a portrait on a wall from some position in the room other than from the ceiling.

Installation at Detroit, Michigan

General Information: The room is 12' 1" x 15' 4" x 8'. Traverse draperies are used across one end, concealing three French windows that open inward, and the opposite end of the room has a large plate glass mirror which reflects the draperies and the valance. The walls, woodwork and valance across the draperies are painted a soft gray green (60% RF). The ceiling has a matte finish painted a delicate pinkish cream (75% RF). This forms a natural cove above the top of a decorative cornice which extends completely around the room. The carpet is a moderate gray green (25% RF). Slip covers for the chairs are made of heavy cotton fabric in a deep rose shade and this color is repeated in the deepest shade of rose in the draperies. Clear tones of red, deep rose and green on a cream colored background form the floral pattern of the draperies.

The portrait, framed in gold plaster, measures 29" x 24" (frame dimensions are 38" x 33"). The portrait figure is mostly in black against a forest green background. The usual placement of the small buffet is slightly off center of the room and as a result, the portrait (centered above the buffet) is 7' 11" from the window wall.

Installation: General lighting is provided by a semi-indirect opal glass fixture (Moe Bros. #1023) containing three 60-watt filament lamps and mounted about 4 inches below the ceiling.

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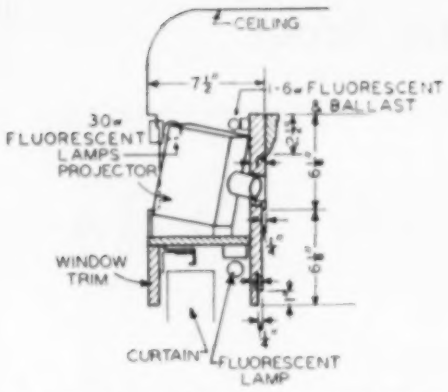


A 12-foot long white pine valance (approximately one inch thick) extends 7 inches out from the wall and is 12 inches deep; its top follows the natural line of the decorative plastic cornice and drops 8 inches below the normal ceiling line. A wooden strip anchored to the top of the window trim and extending out to the valance board provides a firm mounting for the projector which illuminates the portrait. To the bottom of this board, close to the inner side of the valance, are mounted four 30-watt 3500K fluorescent tubes (on Wiremold channel) which direct light down upon the draperies. Attached above the window frame are four additional 30-watt fluorescent tubes located to the rear and top of the projector, being concealed from view from any part of the room by the top of the valance. Light from these tubes is directed upward and outward with the help of the ceiling cove. Single ballasts for these fixtures are located in the basement. To eliminate a slight shadow on the ceiling, one 6-watt fluorescent tube is mounted on the back of the valance board above the projector machine.

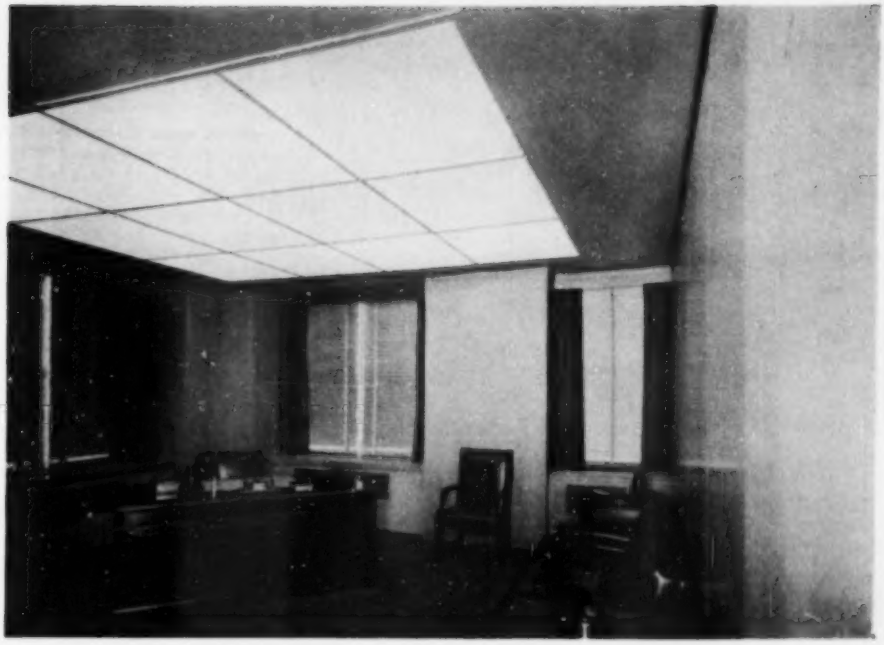
The portrait (excluding frame) is lighted from a projector machine (Society for Visual Education, Model Q) using a 100-watt projection lamp. The beam of light from this machine is focused through a 1⅜" opening cut on an angle in the valance board. The projector is located on the partition attached to the window frame and is tilted to an 11 degree angle below the horizontal plane. It is turned approximately 50 degrees from the wall. Four thin metal strips frame the beam of light and focus it on the portrait only. The distance from the machine to the portrait is 9' 8". The inside of the 1⅜" opening is painted the same gray green as the valance board to avoid a bright spot in the valance.

Illumination and brightness measurements are indicated below:

General lighting (30 inches above floor)	5 ft-c
Local lighting	
Table top (directly under fixture)	10 ft-c
Table top (edge near window with valance lighting)	6 ft-c
Portrait	6 ft-c
Brightnesses	
Ceiling fixture	200 ft-L
Drapery	
top	150 ft-L
bottom	20 ft-L
Ceiling	
general	20 ft-L
over valance	240 ft-L

Lighting data submitted by Mrs. Marjorie Dygert and Miss Mary Taeuber of the Detroit Edison Company, as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society
51 Madison Avenue, New York 10, N. Y.



"Built-in" Office Lighting

By ERVING G. BERNSTEIN

FROM the earliest planning stages of the new modern offices of the Lone Star Cement Corp., New York City, lighting was considered a major facility and design factor. Floor, wall and ceiling treatment were all planned to contribute to the overall lighting results.

One important problem involved in the plans was the utilization of deep interior office areas. Concentration of office workers in large interior areas brings with it the difficulty of creating a pleasant environment where natural daylight is not available. The architect's ingenuity is required, here more than ever, to design and apply planned lighting, air conditioning, sound control and other architectural elements in such a way as to maintain normal, or even increased, office efficiency. For this large interior area in the Lone Star offices, the architect provided high levels (60 footcandles maintained) of recessed fluorescent lighting.

Three types of lighting design were employed in these new offices. General office areas, such as the Accounting and Engineering Departments, are lighted by lens-shielded Troffers recessed in metal pan, T-bar snap-in type acoustical ceilings. The same equipment is used in most of the private offices. Other areas, such as the offices of the President and the Chairman of the Board of Directors, the Board Room and the Reception Room, feature recessed skylight units. Corridors are lighted by custom-designed totally indirect fluorescent troughs.

The office of the President, shown above, measures 16 feet by 17½ feet, with a 9-foot ceiling. Walls are paneled with a natural wood of 20 per cent reflectance. Two of the walls are mainly window area with natural aluminum venetian blinds. Ceiling reflectance is 80 per cent. An average 60 footcandles maintained at desk-top level is produced by a recessed skylight unit 12½ feet by 11½ feet with twenty 30-watt and ten 20-watt T12 standard white lamps. Shielding is provided by 12 plastic panels, corrugated. Lamps are mounted 11½ inches above the plastic panels with 12 inches between lamp rows. Brightness measured 2.9 candles per square inch on the fixture

MR. BERNSTEIN is associated with the Frink Corp., Long Island City, N. Y.

Reception Room. Plastic-shielded fluorescent skylight provides 33 footcandles maintained. The rough terrazzo wall behind the receptionist's desk provides an excellent background for the highlighted trade mark, name and bronze sculpture.

and 1.5 candles per square inch on the ceiling. Wiring is on two individual circuits to provide a choice of two levels of illumination.

The Reception Room (above) also features a recessed skylight unit, providing an average 33 footcandles maintained. This room is 16 by 30 feet with an 8-foot two-inch ceiling. The skylight, 7 by 14 feet, has twenty 30-watt T12 standard white lamps shielded by ten corrugated plastic panels. Two walls are aluminum-framed glass panels, one is polished marble and one is gray terrazzo. Ceiling reflectance is 80 per cent; wall reflectance averages 50 per cent. A totally indirect cove and six recessed adjustable spotlights are used to highlight the decorative details on the wall behind the receptionist's desk. The plastic panels used for both these skylights, with a transmission factor of 60 per cent, provide an even distribution of light over the entire luminous area with minimum surface brightness. For both comfort and appearance, the result is very pleasing.

Totally indirect slimline troughs produce 20 footcandles at 30 inches above the floor of the corridor.

For the general office areas, such as the Accounting Department, and in other private offices, shallow recessed Troffers are installed in the metal pan, T-bar, snap-in type acoustical ceiling. Directional lens control glass is used in the troffers, to reduce surface brightness to the lowest practicable levels both lengthwise and crosswise of the unit, with low brightness contrast ratios between luminaires and surrounding ceiling area. An average 60 footcandles maintained is provided in the general offices, with 70 footcandles in the drafting room. The three-lamp four-foot Troffers in the general offices are mounted in 8-foot lengths, 7 feet on centers, with one foot between runs. In the drafting room, the runs are mounted 6 feet on centers.

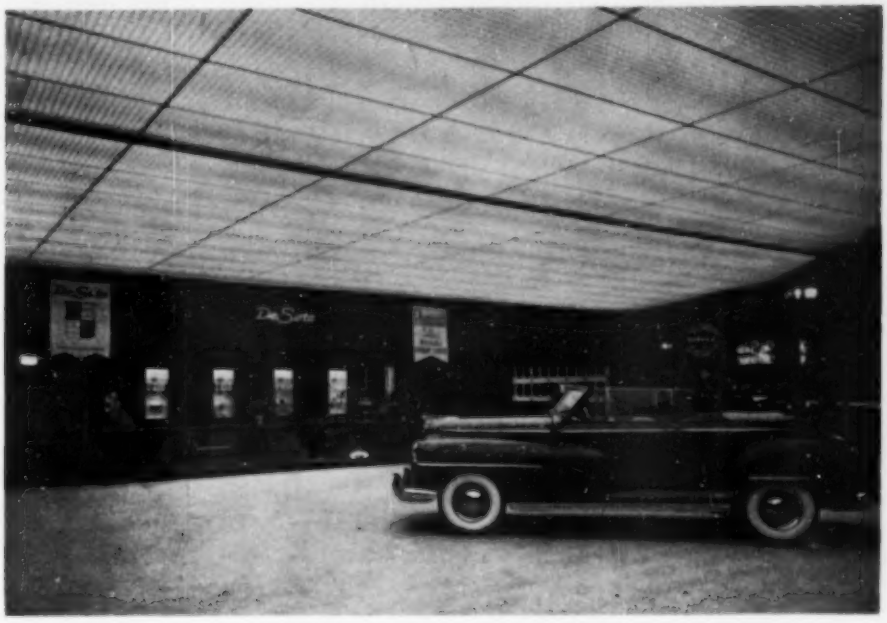
Attention to light conditioning is further emphasized in the light colored rubber tile floors (reflectance 35 per cent), the light wood finishes on desks and chairs, and the cheerful high-reflectance colored paints on the walls.

This example of modern planned lighting application is proving its effectiveness for the cement company, in terms of office efficiency, appearance and general satisfaction.

Credit for the installation goes to Kenneth H. Ripnen Co., Inc., architect; Smith and Silverman, engineer; and Fischback & Moore, Inc., electrical contractor.

Louverall Lighting for an Automobile Showroom

LIGHTING OBJECTIVE: To light a modern auto showroom to display cars attractively using light sources concealed from normal view.



Installation at Nellenback Bros, Inc., 800 South Salina Street, Syracuse, New York

General Information: The showroom is of irregular shape having floor to ceiling glass on exposed sides. Ceiling height is approximately 16 feet. Room surfaces at the time of test were as follows:

ceiling	flat white	80% RF
walls	green plaster	10% RF
	natural birch	20-25% RF
floor	tan terrazza	20-25% RF
louvers	white	75% RF

Installation: Continuous rows of 3500K T-8 96-inch 200 ma slimline lamps are mounted on 3-foot centers 22 inches above Benjamin "Sky-Glo" louvers. The louvers, installed in 3′ x 3′ panels with strap hanger ceiling supports every 3′ x 6′, are 12 feet above the floor and 4 feet below the structural ceiling. Approximately 2.5 watts per square foot produce an average maintained illumination level of 28 footcandles on a horizontal plane 30 inches above the floor, with 10 footcandles vertical illumination on the car body.

Brightnesses are indicated below:

louvers (at 45°)	90 footlamberts
floor	9 footlamberts
wall (green)	2.5 footlamberts
(wood)	4.0 footlamberts

Lighting data submitted by Central New York Power Corporation, Syracuse, New York as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society
51 Madison Avenue, New York 10, N. Y.

Series XV 9-50

A.I.A. File No. 31/13

Modern Dignity in a Canadian Bank

TORONTO, Canada is proud of this banking room. It is the new building of the Bank of Montreal, in Toronto, in service now about one year.

Lighting plans for it received special attention by the architects.* Plans for the building from the start included carefully thought-out architectural lighting. One feature of this is shown in the photograph above — the main banking chamber. Down the center of the room are two balanced rows of 22 recessed units octagonal in shape, each with five 500-watt lamps and silver-mirrored reflectors. These units have specially designed louvers finished in an applied bronze. Twelve indirect pendent luminaires are suspended from the centers of alternate octagonal louvers. The luminaires are semi-parabolic in shape, of case aluminum, finished in bronze, using single 500-watt lamps.

On each side of the room — over the work area — two rows of alternate fluorescent and incandescent units, using 85-watt, 60-inch, and 500-watt lamps respectively, furnish 40 footcandles on the working plane. Power restrictions at present in effect in Toronto, necessitating only partial use of the facilities, have unfortunately cut this to 25 footcandles for the time being.

Along the west wall, which is of paneled wood, shown at left in the photograph, the incandescent units are fitted with asymmetrical reflectors so that the wall area may be evenly lighted.

Fluorescent strip using 40-watt lamps concealed in window soffits, highlights the draperies on the north wall.

The Vice-President's Reception Room, where no visual work is required, is lighted to a level of 12 footcandles. Wall panels are light walnut with a reflectance of about 25 per cent; table and desk are also of light walnut of 35 per cent reflectance. Fourteen wall coffers, three feet wide by six

Data for this installation were supplied by G. F. Dean of the Toronto Hydro-Electric System of Ontario, Toronto.

*Architects for this new Bank of Montreal were Chapman, Oxley and Facey; Marani and Morris; and K. R. Blatherwick, Toronto.

Vice-President's Reception Room of the Toronto Bank of Montreal. The room is 16'6" by 25'6", with a maximum ceiling height of 12', minimum 10'. Since no clerical or stenographic work is required here, 12 footcandles have been provided by the coffer and cove installation.

Photos courtesy of Curtis Lighting of Canada, Ltd.

inches deep are equipped with 60-watt bowl reflector lamps. A center cove is lighted with sixteen 40-watt warm white fluorescent lamps, mounted continuously.

In the Board Room, lower right, where meetings are held once a month, 25 footcandles on the table is provided by the louvered ceiling unit. Louver sections for this installation are three-inch square, of one-quarter-inch plywood, shielding 36 five-foot 85-watt warm white fluorescent lamps. The ivory-colored cove is illuminated by spill light from these lamps. Table and ceiling of this room are of limed oak with a reflectance of approximately 45 per cent; chairs are teal blue.

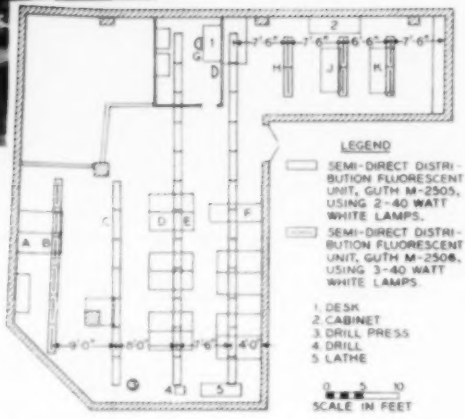
Board Room of the Bank of Montreal is in use only once a month. This room is 18½'by 31' in size, with a ceiling height below the louver of approximately 11'. Footcandle readings on the board table show a maximum value of 25 footcandles. Thirty-six 85-watt fluorescent lamps are employed, shielded by 3" square louvers.

A.I.A. File No. 31/13

Lighting an Electricians' Shop

LIGHTING OBJECTIVE: To provide quality lighting for tasks performed in an electricians' shop.

Installation at Public Service Electric and Gas Company's Terminal Building, Newark, New Jersey.


LEGEND
SEMI-DIRECT DISTRIBUTION FLUORESCENT UNIT, GUTH M-2505, USING 2-40 WATT WHITE LAMPS.
SEMI-DIRECT DISTRIBUTION FLUORESCENT UNIT, GUTH M-2506, USING 3-40 WATT WHITE LAMPS.
1. DESK
2. CABINET
3. DRILL PRESS
4. DRILL
5. LATHE
SCALE IN FEET

General Information: Surface characteristics are as follows:

Ceiling	white	76% RF
Upper wall	white	76% RF
Dado	tan	23% RF
Floor	concrete	12 to 15% RF
Tops of work tables	maple	15 to 26% RF

Ceiling height is 16 feet 6 inches. See plan view at right.

Installation: Semi-direct Guth "Futurliter" luminaires containing 40-watt white fluorescent lamps are mounted 12 feet above the floor, spaced as shown in plan view. Resultant levels of illumination and brightnesses after 200 hours operation are indicated below:

Illumination

Location (See Plan View)	Footcandles
A	43
B	60
C	60
D	59
E	60
F	49
G	53
H	54
J	58
K	55

Brightness

Location	Footlamberts
walls —	
upper	18 to 24
dado	3.2 to 4.0
floor	2.8 to 3.6
top of work bench	7.0
luminaire —	
reflector	280
outside of shield	6.3

Lighting data submitted by W. S. Greenwood, Public Service Electric and Gas Company, Newark, New Jersey as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 51 Madison Avenue, New York 10, New York

Series XV 9-50

A.I.A. File No. 31/13

Lighting–Its Role in Contemporary Home Decoration—Part I

Essential Substance of the I.E.S. Technical Committee Report "Contemporary Lighting in Modern and Traditional Interiors"

THE character of an interior is most often fixed by its architectural or decorative treatment. But the impression it makes can readily be changed—as a sunlit room is changed by the passing of a cloud or by nightfall. Light is an element of design; it can be brash, obvious, dull, or distracting. It can be harmonious, unobtrusive, scintillating, satisfying, and adaptable to the use and spirit of the interior.

So extensive are these possibilities that artificial lighting can be considered as a major element to enhance the carefully considered work of architect and interior designer. Lighting should afford more than mere pictorial pleasure in embellishing surroundings. It should also encompass the broader aspects of living comfort for those who occupy the interior.

Lighting design must become a subjective as well as an objective art. It is ideally applied to home interiors only when its media — fixtures, portable lamps, applied or built-in units — are keyed in design and mechanics to the architectural and decorative pattern. Its effects should be appropriate to the character of the interior and interests of the individuals who live with it.

More recently the new concept of good residential lighting has sprung from a background of scientific activity. Research has established that light and the associated effort of seeing have profound effect on human beings. This effect may be mild or severe in relation both to the quantity and the quality of lighting and to the difficulty and duration of the seeing endeavor.

With these humanitarian requirements of light and lighting revealed today, there is a growing demand for more and better lighting. Marked advances have been made in variety, sizes, light output, light control, and diffusion of both incandescent bulbs and fluorescent tubes. Expanding varieties of lighting equipments are being designed to shield these light sources and to control their light output for more useful and effective light distribution. Cornice lighting, valance lighting, niche lighting, spot lighting, and other architectural lighting as well as more advanced interpretations in portable lamps and fixtures are important additions to today's lighting repertoire. The effectiveness of new equipment and of architectural lighting techniques is highly dependent upon environment. Thus environment becomes an integral part of a lighting installation. Matte or dull finishes of appropriate reflectance are to be sought on the ceiling, walls, and floor if high visual comfort is to be attained.

Lighting developments of our time challenge the creative ingenuity of designers to integrate modern lighting with all current styles of home decoration. Particularly complex is the problem of blending contemporary lighting technique and equipment for greater living comfort in rooms of authentic early period design.

Few fixtures and lamps originally designed for candles or oil are readily adapted for even the smaller sizes of standard present-day incandescent bulbs. They cannot provide suitable amounts of light for contemporary living, and they become annoying sources of glare. Often, too, the original graceful lines of early period fixtures are distorted when wired for electricity. Traditional lighting units such as the chandelier, wall sconce, girandole, and torchere may in form and motif serve as a basis for new designs created for today's light sources and lighting effects. They may be used in their original concept to establish the traditional feeling, while the essential lighting comes from sources "hidden" within walls or ceiling.

In interiors in which no critical visual work is done, the interior designer may range far and wide in the use of high gloss or dark finishes. Light in varying amounts may be employed primarily as a vital medium of expression. Here the lighting designer should avoid such functional lighting techniques as are not in proper harmony with the designer's or the room's intent. The discomfort, however, that arises from extreme differences in brightness should always be kept in mind. Because most of the rooms in homes of today are used for many activities, the lighting plan should provide a flexibility which will appropriately serve each.

In this publication are assembled illustrations of a number of lighting methods applied to Traditional and Modern interiors. The purpose of each lighting installation is stated and pertinent lighting data and essential scaled drawings are included with a short description and appraisal of the end result. Other interpretations and solutions of the problems included are possible.

This work cannot offer a complete treatment of all possible lighting problems, handled suitably for all popular decorative styles. It points up the powerful esthetic, psychological, and utilitarian services of light and lighting and the need for increasing design attention to its role in contemporary home decoration.

Figure 1-A

Cove Lighting

Suitably scaled and detailed moldings of wood, plaster, or metal mounted on side walls may serve to conceal light sources for pleasing indirect illumination. Current developments in extruded plastic forms suggest the future use of luminous coves. The design of the exterior of the cove usually repeats or reflects other structural design elements in the room such as woodwork trim in window framing, cornice, baseboard, or fireplace. Some designers prefer a simple and frankly modern treatment even in a period room. When it is possible to furr out a wall or set back the wall above the cove, a recessed treatment can be achieved which readily overcomes the occasional objection to the applied cove and also provides a more even light distribution over the entire ceiling.

Coves may be on all four walls of a room, although their use on two opposite walls is generally more pleasing. Their purpose is to provide moderate levels of over-all lighting. Their effectiveness depends upon observance of a number of dimensional and installation details. The light sources should be at least 10 to 12 inches below the ceiling; when the distance can be greater, the distribution of the light on the ceiling is improved. With the tendency toward lower ceilings in many homes today, desirable results are difficult to attain unless the cove is recessed as in Fig. 1, or is shallow and wide as in Fig. 3. As room dimensions increase, there is an increasing sense of darkness in the center of the ceiling in contrast to the higher brightness of the ceiling nearer the cove. It is thus found in rooms of average height that it is not practical to use coves on walls that are more than 18 feet apart.

Metallic finishes or very rough or swirl plaster on ceilings should be avoided; matte papers or the "flattest" possible paints of high reflectance (65 to 80 per cent) should be used. The wall above the cove should have a reasonably high reflectance. As a general rule excessive wall brightness may be avoided by placing a tubular light source so that the center of it is at least four and one-half inches away from the wall. To assure good results in the ceiling distribution (without sharp cutoff) the lamps must be placed high in the cove. The sockets of tubular sources when placed end to end provide a continuous line of lighting. The wiring channel and interior finish of the cove should be white for maximum efficiency and evenness of lighting effect, except where specially designed reflectors are used. The cove design should provide complete shielding of the lighting devices from all normal viewing positions (including positions in adjoining rooms).

There are rooms and situations in which coves are utilized merely to produce narrow bands of light; then the dimensions given need not be adhered to so closely.

Fluorescent tubes (See later issue) greatly expand the possibilities of cove lighting since their efficiency, variety of lengths and small diameters make them suitable for the purpose both from appearance and lighting

considerations. Different lengths of tubes may be used in a single cove, but where possible it is best to use tubes of the same diameter. Otherwise, a variation in wall brightness may be apparent. Likewise, the narrow diameter tubes should all be operated at the same current value.

The size, shape and lower installation cost of lumilines make them applicable in coves. However, the electrical consumption per foot of cove in the case of the lumiline lamp is approximately four times more than when using fluorescent lamps. The amount of light generated would be the same in each case.

Cove lighting does not, except in very small rooms, provide levels of room illumination sufficient for reading or other close eyework. It is difficult to design a cove incorporating a sufficient number of light sources to compensate for the relatively low efficiency of cove lighting installations. Cove lighting alone is very soft, flat and tends to be monotonous without the use of other lighting treatments to add highlights and shadows of interest as seen in Fig. 1-B.

General Information: In this modern living-dining room, (See Figs. 1-A and 1-B) two-wall cove lighting proved an excellent solution to two specific lighting requirements. The first was the provision of a relatively high level of room lighting to balance comfortably the high levels of local lighting obtained at all furniture groupings by a combination of downlights and portable lamps, Fig. 1-A. The second was the attainment of a restful atmosphere for conversation or entertaining. A number of dramatic built-in lighting ideas for sparkle and interest supplement the soft, relaxing light from the coves.

Figure 1-B

The living area is approximately 18 x 23 feet; ceiling height is eight feet nine inches. The ceiling is off-white acoustical tile, the walls resemble the color of natural birch bark, and the carpet is sage blue. Light blues, yellow-green, and flamingo red are in the furnishings. Coves 21 feet 4 inches long are inset in the long walls at such an angle that their shielding glass drops into place without fastening. The lightly-etched glass shields are in four pieces for each cove, the joining covered with decorative pierced metal strips. Eight 64-inch fluorescent tubes are used and operated at 200 ma. The total cove installation consumes 436 watts. The installation method, Fig. 2, reduces the floor width by ten inches but allows space within the side walls for unusual built-in treatments. The high reflectance colors selected for walls, carpet, and furnishings are important in effecting the results seen in Fig. 1-B.

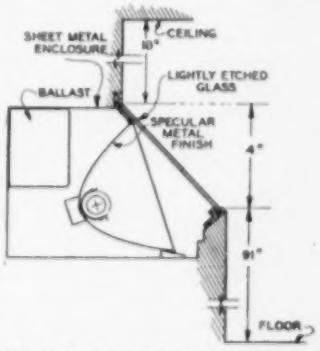


Figure 2. Vertical section through cove and wireway for T-6 fluorescent tubes in 64 in lengths.

These wall-incorporated coves achieve an unusually even brightness of wall and ceiling. The too-frequent high brightness on the adjacent wall and the frequent dark area in the center of the ceiling are avoided. The glass cover plates (70 ft-L) as viewed from seating positions are less than four times as bright as the upper wall, and the change in wall brightness from floor to ceiling is less than ten to one. The ceiling brightness variation is of the same order. The illumination measurements 30 inches above the floor vary but slightly from 10 footcandles. If the tubes were operated on 300 ma ballasts, this value would be increased to 12 footcandles. This represents a practical maximum for a room of these dimensions and reflectances since the physical disposition of additional tubes to obtain more light offers serious design problems.

Figure 3

General Information: Two lighting effects in this Traditional dining room (left) were desired. One system to provide soft general room lighting is discussed here. The other, to accent the dining table accessories is detailed in Fig. 24. A requisite was that the lighting elements should be functional and of modern design as a direct contrast to the earlier period decoration of the room.

The room is 12 x 13 feet 3 inches, with an 8 foot ceiling. The woodwork, ceiling, and window wall of the room are painted white, while the other walls are treated with paper of delicate Chinese Modern design. The wallpaper motif — a green vine pattern with accents of gold, black, and Chinese red on a white background — is reproduced identically in the drapery fabric.

To fulfill the first lighting requisite coves of simple design are used on the two long walls. Each cove is made in three sections of bent sheet metal which have been welded together and painted white inside and out. By blocking the wiring channel out from the wall, shadows from the sockets as well as excessive wall brightness are avoided. Four 30-watt tubes are mounted end to end in each cove. The ballasts are installed in the basement.

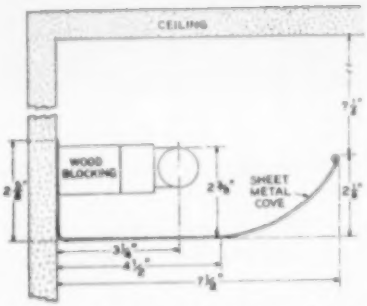


Figure 4. Section through cove using T-8, 30-watt fluorescent tubes; ballasts installed in basement.

It was necessary to make some compromise on the mounting height of the cove because of the low ceiling and the decorative requisite of keeping the top edge of the cove in line with the drapery valance. Note in Fig. 4 the special cove design to compensate for this close spacing. The shallow cove depth (2⅛ in), the wide, gradual curve from wall to front edge, and the tube placement are all essential features. In addition, the small room dimensions and high reflectance of walls and ceiling aid in the cove's success in supplying a highly uniform illumination of 16 footcandles over the table top. The brightest area of the ceiling directly above the cove is 275 footlamberts.

The rather unusual selection of the "cool" white tubes was the result of a trial installation. The client's wish was to retain at night the daytime effect of a chaste white interior. The "cool" white tubes accomplish this best and also intensify the greens in the paper and draperies. When a "warmer" room atmosphere is desired, fluorescent tubes that produce such an effect may be selected.

General Information: In the remodeled breakfast room (see Fig. 5 facing page) the architect wished to attain a very soft relaxing atmosphere without the use of conventional lighting equipment. The client requested sufficient light on the center table for short-period reading.

The room is eleven and one-half feet square with a nine foot ceiling. The room has a simple classic treatment with white woodwork and walls with floral border trim. A wood molding is placed 12 inches from the ceiling; it is continuous except for short breaks to accommodate the keystone pediment of the two opposite niches. The cove is lined with polished metal and the upper wall is faced with mirror to obtain the maximum light output and the minimum upper-wall brightness. A combination of 20-and 30-watt fluorescent tubes is used to fit the space for a continuous line of light within the cove. With the application of the mirror to the upper wall, the variation in reflected brightness of the different diameter tubes is not visible. There is a total of 420 watts, not including the ballast wattage.

Contrary to the recommendation, a slightly metallic silver paper was used on the ceiling. This creates some undesirable specular reflection and prevents the more even distribution of light across the ceiling that would be possible with a matte ceiling. The desired illumination level of 20 footcandles across the table top is obtained.

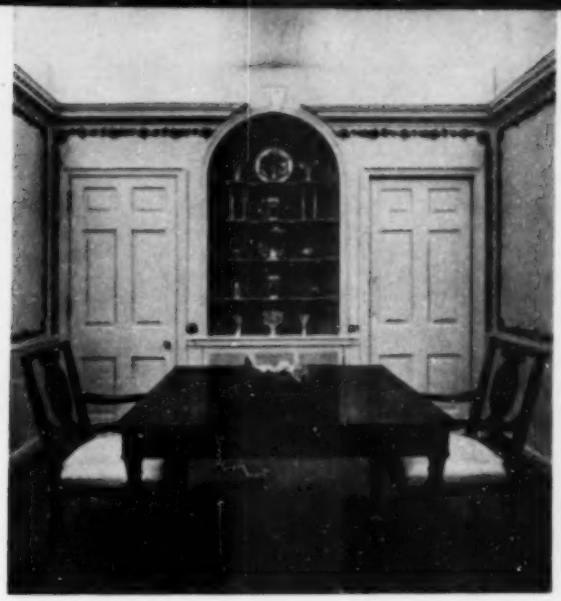


Figure 5

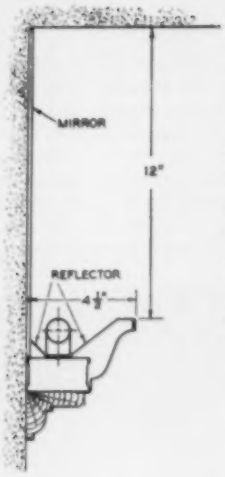


Figure 6. Section through continuous cove; ballasts in wiring channel. The close spacing between tubes and side wall and the two different tube diameters (T-8 and T-12) would be unsatisfactory without the use of mirror on the upper side walls.

General Information: In the Contemporary dining room below, a continuous four-wall cove produces very pleasant, moderate lighting (8 ft-c on the table top).

The room is 13 x 15 feet with an eight and one-half foot ceiling. The walls below the cove are a warm gray-pink; the upper walls and ceiling are a delicate shell-pink reflecting a flattering light into the room and on its occupants. The cove is basically a horizontal extension of a plaster soffit with the face of the cove a curved wood molding. Continuous cool white, 12 mm cold cathode tubing is concealed behind the cove molding. At no place above the cove does the brightness exceed 50 footlamberts.

For those times when illumination from the cove is not desired, the table centerpiece can be accented by light from a pin-hole spotlight in the ceiling. Strips of incandescent bulbs (not indicated in Fig. 7) are concealed above the drapery and behind the cove. This drapery is used at opposite ends of the room. The spotlight, the window illumination, and the cove lighting may be used separately or combined to suit the varying moods and uses of the room.

Figure 8

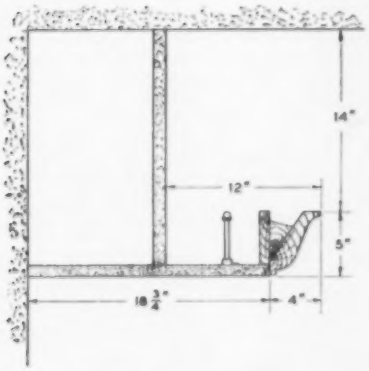


Figure 7. Section through continuous cove using 6 ft and 7 ft lengths of 12 mm cold cathode tubing; transformers are located elsewhere.

Recessed Lighting

Recessed lighting is applicable in every room of the home. As discussed here the term includes built-in panels of relatively large area for diffuse illumination and also the more concentrating type of downlighting units. Recessed lighting may be purely for decorative effect or it may be designed to provide utilitarian illumination — general or local.

Recessed Panels. — Recessed ceiling units used for general room lighting are often unsatisfactory and disappointing to those who demand them in a desire to eliminate the more traditional ceiling-mounted or suspended luminaires. This may be accounted for by several facts: (1) the use of too small a unit in a large room, (2) the limited area that is illuminated by a small unit and (3) the lack of light on the ceiling which causes an annoying contrast between the lighting unit and the dark surround. For these reasons it is not advisable to consider small recessed units as a means of general illumination; however, larger recessed units of low brightness may be used for general lighting if properly spaced. They are usually appropriate for use in recreation rooms or utility areas such as kitchens, bathrooms, and halls.

Recessed panels of comparatively large scale are acceptable when used to provide diffused local lighting from over the head of a bed, or over a davenport, dressing table, game tables, or utility work centers. There are also many places where the recessed boxes of smaller dimensions may be used to provide local lighting over a rather limited area: card table, steps, niches, foyer, etc.

The interior finish of recessed boxes should be of high reflectance to provide maximum light output. Built-in units may be shielded by panels of glass or plastic, or by louvers. Lens plates of clear or prismatic glass may be specified for either spreading the light or concentrating it. When glass shielding is used it should be of such character as to prevent unpleasant brightness; opal, configurated and other dispersive glasses have application for all light sources; in general, lightly etched or louvered glasses are more suitable for fluorescent tubes.

Recessed Spots. — Recessed spot-lighting is most often used when decorative accent lighting is desired, as over a dining table, or to light game boards, murals, books, pictures and art objects. Units built into the ceiling and properly shielded will provide comfortable utilitarian local lighting if sufficient room illumination is provided. Ceiling apertures of from three to six inches are required for recessed units using standard reflector and projector bulbs. These have comparatively long life and combine reflector and light source in one bulb, thereby eliminating the need for maintenance other than replacement due to failure. However, the beam or light pattern cannot be framed closely enough to exactly cover paintings, table tops, and art objects. On the other hand, most of the pin-hole type spot units with smaller ceiling openings (one to two inches) produce accurately-controlled beams. Some of these utilize special bulbs of relatively short life and require periodic maintenance of bulb, lens, and reflector and proper adjustment of optical system for best lighting results. *(Continued next page)*

Figure 9

General Information: In keeping with the simple architectural lines of this library (left), recessed fluorescent panels were installed to provide the general illumination. The room, 11 x 14 feet 6 inches with a nine foot ceiling, has walls and ceiling of light-colored natural chestnut panelling. Two rows of units are recessed in the ceiling, extending from wall to wall the length of the room and spaced six feet apart. Each row is made up of three units mounted end to end, and in each unit are two 40-watt fluorescent tubes, making a total of twelve. The tubes are shielded by etched glass panels. The comfort of the installation is due to low glass-surface brightness and low contrasts between the glass and the adjoining light-colored wood-panelled ceiling. The comparatively high reflectance of the walls, rug and upholstery also adds to the comfort of the lighting installation.

In addition to the 50 footcandles on the desk top from the recessed ceiling luminaires, a lamp on the desk (not shown in the photograph) supplies an extra 35 footcandles of local illumination.

The dictionary in the niche is illuminated to an average of 75 footcandles from a 15-watt fluorescent source concealed behind the decorative wood valance.

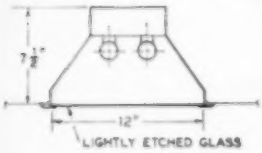


Figure 10. Section through recessed troffer; with T-12 tubes and ballasts in troffers.

← *Figure 11*

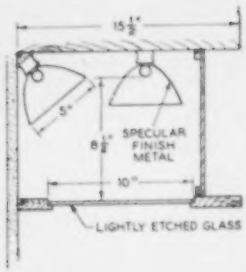


Figure 12. Section through tubes and reflectors over davenport; ballasts in separate box. 42 in. T-6 fluorescent tubes are used. Shielding glass is 56 inches above seat top of davenport.

Figure 13 →

For a pleasant and comfortable effect, spotlighting should be considered an accent to be used only as a supplement to general lighting or where there is background illumination as in Figs. 20 and 22. To avoid troublesome contrast between the luminous surfaces or apertures of a recessed lighting system and the surrounding ceiling, high reflectance floor coverings and wood surfaces are desirable to reflect light back to the ceiling. Ceiling brightness is increased when the shielding cover is designed to be slightly below the ceiling line. When recessed spots are used over furniture, restrictions are placed on its rearrangement.

Since recessed lighting of any type requires space allowance above the ceiling line varying from approximately six inches to 18 inches, it is obvious that such lighting is more practically considered when the home is in the blueprint stage. This does not mean that some types of recessed lighting cannot be accomplished, although usually at greater cost, in existing homes.

General Information: In the example at extreme top (Fig. 11), the basic room design, the lighting, and the furnishings were all developed simultaneously before construction was started. A recess, formed by two bookcases, was planned for a seven-foot sofa. A false bookshelf is used to lower the soffit above the recess and to provide space in which to install suitable lighting. Thus an opening approximately ten inches deep, 13 inches wide, and seven feet two inches long is formed. In it is recessed a lighting system designed to provide either excellent reading illumination at every location on the sofa or a lower level for lighting the picture and sofa. The cross section (Fig. 12) of the installation shows the simple wood trim which holds the shielding glassware. Because of the length of the opening two pieces of glass are used for easier handling in cleaning and lamp replacement. Two rows, individually switch-controlled, of two 42-inch small diameter (three-quarter inches) tubes are used and operated at 200 ma. The reflectors on the back row are tipped forward to direct more light to the reading plane — 40 footcandles with both rows lighted. "Cool" white fluorescent tubes were selected because their color quality accentuated to best advantage the ice-blue upholstery of the sofa. The vertical direction and the color quality of the light on the upholstery gave dramatic emphasis to its deep pile and patterned weave.

Added highlight (Fig.13) and variable reflections from the bar bottles and glasses are gained in the use of recessed lighting in the soffit above the built-in bar. Two rows, each with two 40-watt fluorescent tubes end-to-end are used, shielded with "egg-crate" louvers. The appearance and shielding is in keeping with this setting but would not be true of Fig. 11.

Figure 14

General Information: This modern bedroom shown above is 13 x 17 feet with an 8 foot 8 inch ceiling finished in oyster-white. The placement of a bed headboard in a wall recess suggests the possibility of overhead recessed lighting for reading in bed. The room walls are a delicate shell-pink, and the rug a rose color. Light for reading in bed is provided by two rows of three 30-watt fluorescent tubes in a metal box recessed in the soffit above (Fig. 15). The aperture is covered with lightly etched glass which is concealed by a ruffled valance. Approximately 25 footcandles of illumination are produced for reading.

The wall of the recess is mirrored, reflecting the opposite side of the room. A mirror, when placed close to a light source, will often reflect an annoying image of the light source. In this case, the decorative fabric ruffle completely shields the reflection of the glass panel at the top of the mirrored wall. Its low brightness, however, would not have been objectionable on either direct or reflected viewing.

The objects in each niche are lighted by two vertically placed 42-inch fluorescent tubes (Fig. 16) operating at 120 ma. While the niche lighting is primarily decorative, it reflects a pleasing glow into the room and adds to the over-all interest of the wall area.

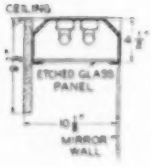


Figure 15. Section through over-bed soffit in which a light box is recessed; ballasts located elsewhere. The glass panel is approx. 6 ft above the mattress top.

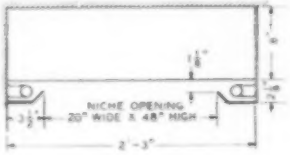


Figure 16. Horizontal section through wall niche; ballast in separate box.

General Information: In the recreation room (shown below) where no more exacting seeing tasks than card playing and occasional reading are done, the lighting was designed primarily for dramatic appeal and supplemented where needed by utilitarian local illumination. The room is 17 x 14 feet with an eight foot six inch ceiling. The lighted walls are treated in a paper of silver background with patterns in chartreuse and green, and two walls and the wood trim are a light green.

The corner card table is lighted by four 15-watt fluorescent tubes recessed in the ceiling (Fig. 17). A level of 20 footcandles is provided. The four corners of the ornamental louver which shields the tubes are decorated by cut-outs of hearts, clubs, diamonds, and spades. In addition to the card table lighting and the illumination from portable lamps not shown in the photograph, light is reflected into the room from the two end walls. Cornices across these walls (Fig. 18) conceal a single continuous row of four 30-watt and one 15-watt fluorescent tubes. Each cornice also conceals two staggered rows of four black light fluorescent tubes which are shielded by a strip of red-purple glass to filter out the visible light. All ballasts are installed remotely.

The scroll designs in the wallpaper are treated with fluorescent paint so that they glow vividly when exposed to ultraviolet radiation from the black light in a comparatively dark room. The magic of this kind of light is more novel than practical, but for those who desire unique decorations and lighting effects, it has many possibilities.

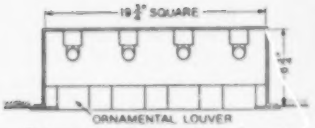


Figure 17. Section through ceiling-recessed light box using T-12 tubes; ballasts in separate box.

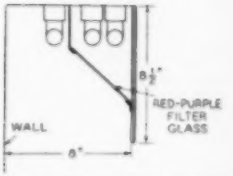


Figure 18. Section through cornice concealing staggered rows of T-8, 30-w, black light tubes and one row of T-8, 30-w white fluorescent tubes; ballasts in separate box.

Figure 19

Figure 20

General Information: Ceiling-recessed downlights are employed for sheer dramatic highlighting or for providing illumination for a specific furniture grouping. In this demonstration living-dining room (above), these aims inspired the further development of a complete ceiling pattern of 20 downlights. A theatrical setting is created for formal entertaining that is sparkling with highlight and shadow. Desirable wall interest and relief from the exotic is supplied by the inclusion of light in architectural wall elements.

The PAR-38 150-watt bulb is used in this application; for lower levels of illumination the R-30 75-watt bulb may be used. Projector bulbs were installed in both spot and flood distribution. The spot type will supply about three times as much illumination, in a more concentrated form over a smaller area, as the flood type bulb. For these bulbs a three-inch aperture proves the best compromise between the too conspicuous larger openings and the too inefficient smaller ones. Good shielding and low brightness is attained by the five-inch spacing between the bulb and cover plate and by the use of a very lightly etched glass plate. Ordinary etched or opal glass becomes overly bright. Low brightness and a 45° shielding may be obtained with a two-inch lower bulb placement if three circular black baffles are inserted above the ceiling line. With the latter method, there is some reduction in illumination. In the installation here (ceiling height eight foot nine inch), there are 90 footcandles delivered on the use planes where the spot type bulb is used. Desirable light on the ceiling is obtained by reflection from the 20 per cent reflectance carpeting.

The arrangement of these ceiling downlights, on a flexible switching plan, allows some variation in furniture placemen nd the use of the lights individually or in groups for varying activities. When downlights are used for cl se-vision tasks, some other room lighting system which provides more luminous walls and ceiling should be combined with the direct lighting for visual comfort.

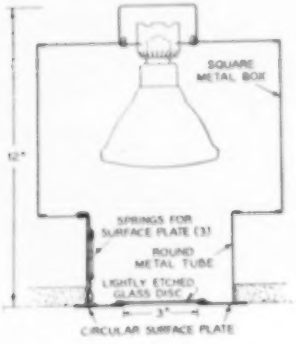


Figure 21. Section through ceiling recessed downlight, custom built to combine the most inconspicuous appearance with easy maintenance.

General Information: It was the plan of the designer to illuminate walls and window areas (not shown) as a "backdrop" against which higher levels of dramatic lighting could be used on the dining table top. (See Fig. 22.)

Cornice, wood trim, and ceiling are white, with two walls a French Grey paper. The other walls are covered with a "chaise and carriage" paper of grey ground with soft red and black accents.

The lighted walls and window curtains reflect approximately 5 footcandles to the table top. Accent lighting is produced by means of a 100-watt, 20-volt lamp in a recessed pin-hole spot unit with adjustable shutters for extending the beam to cover the entire table top (Fig. 23). The unit is relamped and adjusted from below. Recessed lighting is often desired at the dining end of a living-dining room because it is inconspicuous and retains an unbroken ceiling surface.

This concentrating type of unit should not be planned as the only lighting in a dining room, but should be supplemented with lighting from coves, cornices, valances, indirect urns, or other elements capable of providing low-level background illumination.

Figure 22

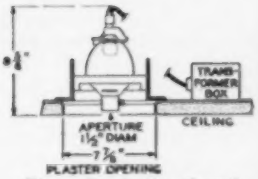


Figure 23. Section through ceiling recessed spot unit, using 100-w, 20-v bayonet-base bulb.

Figure 24

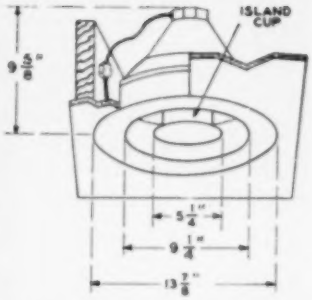


Figure 25. Sectional perspective of recessed fixture. The 5¼ in island cup conceals a 150-w silvered-bowl bulb.

General Information: Details of room size, color scheme and lighting effects desired in this Traditional dining room (above) are given in Fig. 3, Cove Lighting Section.

To dramatize the table setting, a unit of the dimensions shown in Fig. 25 is recessed in the center of the ceiling. In the center of the fixture a 150-watt silvered bowl bulb is concealed burning base up in a gold-plated reflector. This produces an average of 25 footcandles on the table top. The vertical surfaces of the island and the outer ring below the reflector are finished in a dull red; all horizontal surfaces are white. Any desired color may be applied on the vertical planes. In a smaller room or where less illumination is desired a unit designed for a 100-watt silvered bowl bulb may be used.

This particular downlight produces less concentrating and more diffuse lighting than the type discussed in Fig. 22. Therefore, it may be appropriately used by itself. However, the most pleasing effect is gained by the combination of it and the cove lighting.

Window Lighting

Windows are the natural daytime source of light. They may also be effectively utilized as both a useful and a decorative means of artificial lighting. Certain types of window lighting will in addition enhance the colors and texture of curtains and draperies by highlighting the fabric folds. A window valance is perhaps the most conventional method of window lighting. It is usually constructed of wood. The outside surface may be painted or covered with paper, fabric, mirror, or other decorative materials. The inside surface of the valance board and the lighting channel must be painted white to provide a good reflecting surface. The valance should be designed to conform and harmonize with the architectural and decorative elements of the room.

Light from a valance may be direct, indirect, or a combination of direct and indirect. The depth of the valance and its distance from the wall are greatly influenced by the conditions of each installation. As a general rule the valance should be at least six inches in vertical depth and mounted about six inches out from the wall. An increase in the depth of the valance (up to ten inches) may be desirable over windows in high-ceilinged rooms or where the valance is very long.

When a valance is designed to provide any indirect lighting there should be at least ten inches of space between the ceiling and the top edge of the valance. This space is necessary to allow the light to spread out over the ceiling and to avoid excessive ceiling brightness above the valance. The light sources should be positioned as high as possible in the valance, with a *minimum* distance of four inches between the wall or window frame and the center of the tube. This placement is recommended to bring the light out *in front of* the curtains and draperies. It may be necessary to mount the channel on a wood strip to place the tube at the required distance. See Fig. 27. It is essential that the glass curtains and draperies be hung close to the wall or window frame so that the light is distributed down the fabric and not intercepted by deep pleats in the drapery heading. Extension-type drapery brackets should be avoided.

When the fluorescent wiring channel is of the usual type in which the ballast is enclosed, it is best mounted on a wood strip that has been attached to the wall. When ballasts are not in the channel but installed elsewhere, a smaller channel of less weight may be mounted directly on the inside face of the valance near the top. This placement is also applicable with lumiline channels which are lighter in weight.

A small window can be given the illusion of greater width by extending the valance beyond each side of the window and mounting the draperies partially on the wall. This scheme also provides greater length of light with effective result. Where there are several windows in a room they should be treated alike, and tube diameters should be the same whenever possible. Fluorescent tubes are almost always used for window lighting because of their small diameter, length, light output, and "coolness." However, lumilines also prove satisfactory.

The choice of drapery color is important. Fabrics that are light and gay in coloring will be pleasing and luminous. The purpose of valance lighting (except for an indirect valance) is defeated if dark, somber, light-absorbing draperies are used.

Other window lighting methods as shown in Figs. 26, 28, 32 and 35 aim not to light the drapery but to reflect light into a room from the window area.

Figure 26

General Information: The totally indirect lighting of this window valance was desired primarily as decorative accent in this dining room (Fig. 26). Seven feet of 30-watt lumilines, each 18 inches in length, are used end-to-end behind the valance. The wiring channel rests on the metal straps that support the valance (Fig. 27). Lumilines are used here for two reasons: first, because they were comparatively easy to install in an already-decorated room, and secondly, because their color quality was about the same as provided by the lamps in the crystal chandelier.

Light from the shaded crystal chandelier may be augmented by the valance lighting, or for more formal dining the valance lighting alone creates a pleasant background for candlelight.

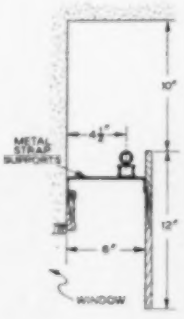


Figure 27. Section through window valance using T-8, 30-w lumilines.

Figure 28-A

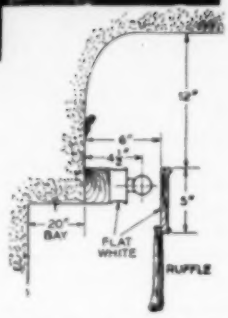


Figure 29. Section through valance over bay window; ballasts in channel.

General Information: In the redecoration of this Colonial living room a completely new lighting system was desired (Figs. 28-A and 28-B). Lighting was needed to provide a more cheerful evening environment than had been previously experienced with portable lamps and to unify the long narrow room. The room is 12 feet 6 inches x 24 feet with an eight foot six inch ceiling. The walls are light green and the wood trim is white. Off-center on the long front wall is an eight foot shallow bay with three windows, each with white Venetian blinds. On the narrow wall at the far end of the room, two small windows flank a recessed bookcase.

One pair of flowered-chintz draperies were hung at either side of the bay opening (Fig. 29), and an 11 foot wood valance was then used to unify the design. This treatment allows a fuller daytime use of the windows and avoids the conventional use of four drapery lengths within the bay. It makes possible and simple, the incorporation of light to "carry over" to evening living the freshness of the window's daytime lighting (Fig. 28-A). The intent in adding light in this case is to highlight the Venetian blinds, not the single-width stationary draperies. The vertical depth of the valance itself is narrow to harmonize with the room woodwork. A white chintz ruffle, matching the drapery ruffle, is added for better proportion and decorative fitness. One 24 inch and two 48 inch fluorescent tubes are used at the bay and in an identical installation which is shown in Fig. 28-B.

The use of 20 feet of fluorescent lighting proved sufficient to obtain an exceedingly pleasant lighting level throughout the room. It creates a delightful setting for conversation and nighttime television viewing as well as a comfortable background for the portable lamp lighting.

Figure 28-B

General Information: In this room (Fig. 31) many varied lighting ideas, some of which are detailed on other pages, are developed for variable combinations to attain appropriate lighting effects for the range of family activity. An important role in the room's versatility is played by the lighted valances. They are used at the four window and door openings which are located on opposite walls in balanced pairs. The valances are designed for maximum flexibility. Each valance allows indirect lighting, or direct lighting, or a combination of both.

The door and window openings were set back three inches so that minimum projection of the balance from the walls could be obtained without too great sacrifice of light distribution over the draperies. Small diameter tubes of one inch or less are most applicable where space is critical, and the 30-watt size fitted the openings here (Fig. 30).

The valance is of unique design. It is made of metal in two slightly separated planes. Large openings in the rear plane are concealed by the scalloped face which is thus backlighted in silhouette with either system. The front face is painted citron to match the ground of the drapery fabric, and the rear plane is flamingo red, the accent color used throughout the interior.

Through their balanced placement in the room and their form, the combined systems illuminate sufficiently large areas of drapery and ceiling to provide eye-pleasing balance to the light from portable lamps.

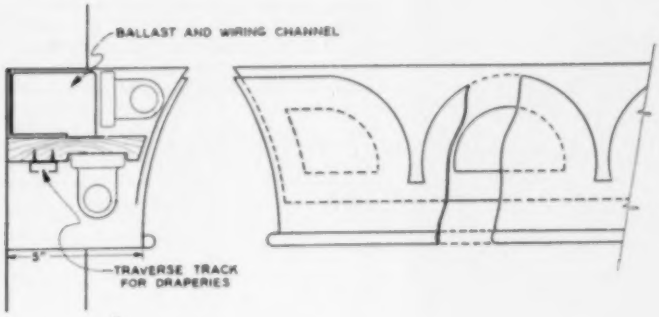


Figure 30. Section through window valance and front view of valance, with openings in back plane dotted.

Figure 31 →

General Information: The lighting in this living-reception room of 18th Century French design was planned to provide practical and decorative illumination in harmony with the decor and variable with the use of the interior (Fig 32). The room is 15 feet x 18 feet with a 12 foot ceiling. General illumination is provided by the crystal chandelier, a pair of wall sconces, and an indirect urn not shown in the photgraph.

In spite of the high windows little natural daylight entered the room because of the close proximity of an adjoining structure. To create an effect of sunshine two fluorescent tubes, set end-to-end vertically behind metal shields and in front of the venetian blinds, are concealed by each drapery (Fig. 33). Light reflected from the blinds produces a daytime effect whenever desired. The ballasts are installed in the hollow space beneath the windows.

The illumination levels provided by the various lighting arrangements are low but nevertheless satisfactory for the interior, since it is used primarily for receptions and entertaining.

← *Figure 32*

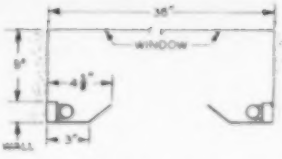


Figure 33. Horizontal section through set back window. Two T-8, 30-watt fluorescent tubes end to end are used on each side.

General Information: Without nighttime lighting a bay window is often an uninteresting recess (see Fig. 35). The daytime beauty and color of flowers, plants, and decorative accessories are lost in semi-darkness. With light incorporated in the design of a bay window two nighttime results can be accomplished: first, and most impressive is the accent that light brings to decorative objects placed in the bay; and secondly, the cheerfulness that can be added to the room by the light reflected from window shades, venetian blinds, or glass curtains.

The wiring channel (including ballast) was mounted on the dropped ceiling of the bay directly behind the fabric-covered valance (Fig. 34). A 40-watt fluorescent tube was used. The lighting effect illustrated could be attained in several ways with either incandescent or fluorescent sources.

The Committee Report "Contemporary Lighting in Modern and Traditional Interiors" to be available in pamphlet form early in November, will be published in ILLUMINATING ENGINEERING in three parts, beginning with this issue. Part II, covering Wall Lighting, Ceiling Fixtures and Portable Lamps will appear in October.

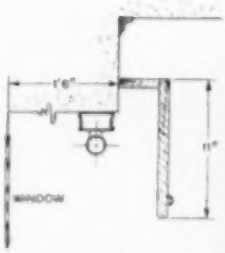


Figure 34. Section through closed top valance which conceals wiring channel, with T-12 tube, mounted on bay soffit.

Figure 35 →

TELECAST

LIGHTING NEWS OF CURRENT INTEREST

New York in October to Be Site Of Northeastern Regional Conference

Plans are approaching completion for the year's first Regional Conference — to be held by the Northeastern Region in New York City on October 26 and 27.

With many east-coast members of I.E.S. perforce missing the Pasadena national conference, the Northeastern Regional Conference is expected to be a very worthwhile "consolation." Excellent technical sessions are being scheduled for both days, and a social program is planned such as only New York City can offer.

Delegates are going to be among those privileged characters who may buy tickets to "South Pacific"; the Conference Banquet is to be held in the colorful "Village Barn" in Greenwich Village; one hundred tickets to other Broadway plays will be on hand.

One feature of the program will be a highly selective "My Best Job" contest, for Sustaining Members only. All entries to this contest are being bound into an attractive pamphlet for distribution at the Conference.

Lillian Eddy of General Electric's New York Office is working up a complete program for ladies attending the Conference. Entertainment arrangements for delegates and guests include a boat trip, an Arthur Godfrey T-V show, and special luncheons. A number of New York Section members have also been appointed to escort visitors on shopping trips.

Reflecting the technical excellence of the Pasadena program, the Northeastern Regional meeting program, as tentatively made up includes:

Thursday, October 26, 1950
Morning Session

Welcome — Carroll O'Shea
National Program — W. Sturrock
Regional Program — R. G. Slauer
Features of this Conference — J. Forbes
Parade of Progress — A. Rodgers & T. C. Sargent

Afternoon Session

Lighting and Color Symposium
Contemporary Lighting Practices for Modern and Traditional Interiors — Myrtle Fahs bender
Fluorescent Lighting in the Home — Lillian Eddy
Dinner at Village Barn

Friday, October 27, 1950
Morning Session

Planned Lighting Forum
Lighting Installations and Radiant Heating — Domina Eberle Spencer
Fluorescent Mercury Lamps and Their Applications

Afternoon Session

Analysis of Glare Appraisal Systems — C. L. Crouch
Interesting Lighting in Northeastern Region
a.—Sustaining Members' Presentations
b.—"Best Lighting Jobs" presented by selected Representatives from New England, Connecticut, and New York Sections.

Northwestern Ohio Chapter, Toledo Celebrates Charter Night

Northwestern Ohio Chapter of I.E.S., the Society's newest group, celebrated its formal inauguration June 27, with a banquet held at the Maumee River Yacht Club. Seventy-two members and guests witnessed the presentation of the Charter; W. A. Stannard, Great Lakes Regional Vice-President, made the presentation to the new Chapter's newly-elected Chairman, H. E. Carney.

For the presentation meeting a special folder was made to contain, on the right, the Charter, and on the left a vellum sheet containing the Chapter's 39 Charter Members. Both the charter and the list of members will eventually be framed for permanent display at Chapter meetings.

Guest speaker at the Charter celebration was Mr. E. L. Bowsher, Superintendent of Toledo Schools, who spoke of his recent trip through Europe.

The Toledo group have already made

NORTHWESTERN Ohio Chapter (left) received its formal Charter at a banquet celebration June 27. H. E. Carney (left) the Chapter's first Chairman receives the congratulations of W. A. Stannard, Regional V-P, who made the presentation. (Right) Board of Managers for the new Northwestern Ohio Chapter just inaugurated at Toledo, Ohio. L. to r. — Elmer Winklejohn H. C. Doner; H. E. Carney, Chairman; Howard Dakin; Rose Coskely, Secretary; C. F. Dougherty; and C. Norton, Treasurer.

plans for a big first year. Elections have been held for the 1950-51 officers and Board. Committee Chairmen have been appointed, and a full program of eight meetings has been scheduled, under the direction of Dr. M. H. Bigelow, of Libby Owens Ford, as Program Chairman.

Considerable increase in local membership in I.E.S. is anticipated after the fall program gets under way, according to the report of M. L. Bettinger, Toledo Edison, who is Chairman of Northwestern Ohio's Membership Committee.

Job Placement Activity Studied by Connecticut Section

In its Summary Report to the Board of Managers, Connecticut Section's Education Committee recommended further action on two interesting studies made last year. These are: 1. The publication of a pamphlet on "Job Opportunities for Illuminating Engineers." 2. The possibility of a Job Placement service. The pamphlet would be intended primarily for the recent graduate and is recommended as the first step in a full-scale job placement activity.

The Section's Education Committee, under the Chairmanship of Professor G. S. Timoshenko of University of Connecticut, feels that the employment of young graduates who have been trained in illuminating engineering is a decisive factor in building up student interest and membership. Such student membership, they feel, is of aid to the Section in securing professional engineering status in the State.

Oregon Students Active in Lighting

A highly enthusiastic student group is apparently developing at quite a pace, in the northwest corner of the country. At a regular meeting of the Oregon Section of I.E.S. held recently, some 55 students of Pacific University, Forest Grove, Oregon, were welcomed as Student Members of the Society. These new members are all undergraduate students in the school of optometry, and are enrolled in a course in illuminating engineering under Dean Richard Feinberg who also served as special chairman for the meeting.

Pacific University was also the scene of an important Seminar on Vision, held early in June (see ILLUMINATING ENGINEERING, August 1950, p. 518).

Program of the Oregon Section meeting held at the University featured a discussion on "Light Sources" by Walter Potter; "Illuminaires" by Ellsworth Feltcher; and "Applications" by Robert E. Lange. Dr. W. C. Giersbach, President of Pacific University, spoke of the tremendous potentialities which lie in close cooperation between illuminating engineering and optometry.

OPTOMETRY students of Pacific University, Forest Grove, Oregon — 55 in number — were welcomed to Student Membership in I.E.S. at a recent meeting of the Oregon Section.

Philadelphia Lighting Course

A 16-session Fundamentals of Illumination Course started September 8 in Philadelphia, sponsored by the Spring Garden Institute in cooperation with the Philadelphia Section of I.E.S. Each session will include lectures and demonstrations, question and discussion periods. Films, slides, visual audio aids and other educational devices will be used wherever possible.

Applications are being accepted now at the Spring Garden Institute, Broad and Spring Garden Streets, Philadelphia, Pa. Tuition is $25.00. Problems to be discussed include:

September 8
LIGHT AND VISION
Dr. W. A. Gilbert, D.Sc., O.D., M.D.

September 15
LIGHTING STANDARDS AND TERMS
G. E. Shoemaker, Philadelphia Elec. Co.

September 22
LIGHTING MEASUREMENTS
Leo Duval, Sylvania Elec. Prod. Inc.

September 29
LIGHT SOURCES
P. R. Holmes, General Electric Co.

October 6
AUXILIARY EQUIPMENT AND CIRCUITS FOR SOURCES
Rev. Thomas Burke, O.S.A., Villanova College

October 13
LIGHT CONTROL
P. R. Holmes, General Elec. Co.

October 20
GLARE AND ITS CONTROL
Robin Adair, Westinghouse Elec. Corp.

October 27
LIGHTING CALCULATIONS
d. H. Beinswinger, Silvray Lighting, Inc.

November 3
COLOR AND LIGHTING
A. A. Brainerd, Philadelphia Electric Co.

November 10
LIGHTING FOR MANUFACTURING OPERATIONS
A. A. Brainerd, Philadelphia Electric Co.

November 17
OFFICE AND SCHOOL LIGHTING
C. C. Shotwell, Philadelphia Electric Co.

November 24
LIGHTING FOR SELLING
C. C. Shotwell, Philadelphia Electric Co.

December 1
STREET AND HIGHWAY LIGHTING
R. M. Hoot, Philadelphia Elec. Company

December 8
SELECTION OF LIGHTING EQUIPMENT
P. R. Thorne, General Elec. Co.

December 15
LIGHTING SURVEYS
M. N. Flynn, Philadelphia Elec. Co.

December 22
ECONOMICS AND MAINTENANCE
F. J. Vorlander, Champion Lamp Company

Who Knows — and What, Survey

Selected readers have received, or shortly will receive, from The A. N. Marquis Company requests for information pertaining to their personal specialties within their occupational fields. Information submitted will be reviewed to determine suitability for inclusion in the company's new reference work, "Who Knows — And What," the Second Edi-

tion of which has been put into immediate compilation following the widespread acceptance of the First Edition, published earlier this year.

The unique reference value of Who Knows stems, according to the publishers, from two major features:

1) the inclusion of only those persons having special skills or knowledge in one or more of thousands of highly specific topics judged by the editors to be subject to general reference interest, together with information on research and experience in these fields; general public or professional eminence is not a deciding factor in selections.

2) the Locator Index, which refers the user by means of a simple key to the listing of any person in the book having special knowledge about any one of the subjects included in the Index.

The company, which also publishes *Who's Who in America*, will welcome any suggestions from readers. Communicate directly with the company at 210 E. Ohio St., Chicago 11.

Lamp Ballast Standards Proposed

Two proposed American Standards on lamp ballasts have just been published for a year's trial and criticism by the American Standards Association. For the first time, ballast manufacturers will have bed-rock specifications upon which to build lamp ballasts, since ballasts need no longer be defined in terms of lamp performance or lamp performance in terms of ballasts. With such standards they could be checked against the new "reference" ballast.

The proposed American Standard Specification for Reference Ballast provides manufacturers with the performance characteristics of ballasts used for testing purposes in terms of, and in relation to, a reference current. The 60-cycle impedance of these reference ballasts is a determining factor in establishing the performance characteristics of the lamps to be used with them. A reference ballast of a definite 60-cycle impedance is readily produced in any laboratory. This, therefore, becomes the real datum point to which both lamp and ballast performance can be referred.

In order for various groups to measure fluorescent lamp ballasts accurately, the proposed American Standard Method of Measurement of Fluorescent Lamp Ballasts has been developed. The particular operating characteristics of fluorescent lamps — high voltage and relatively small currents, voltages having almost square waveform, the effects of temperature and air movement, and other conditions peculiar to the fluorescent lamp — make it necessary to choose instruments carefully and to follow definite procedures if different groups are to obtain similar results in measurements. This standard outlines the procedure for tests of ballasts used with both hot-cathode and cold-cathode fluorescent lamps. It codifies the experience gained in over 12 years of such measurements.

These standards were developed by a committee representing ballast and lamp manufacturers, public utilities, testing laboratories, and government departments, under the procedures of the American Standards Association. All comments received will be considered by the Committee in preparing the completed standard.

Copies of the Proposed American Standard Methods of Measurement of Fluorescent Lamp Ballasts, C82.2, are both available from the American Standards Association, 70 East 45 Street, New York 17, N. Y. at fifty cents per copy. The Proposed American Standard Specification for Fluorescent Lamp Reference Ballasts is available from the American Standards Association at 35 cents per copy.

LIGHTING CALENDAR

Society Events

October 12, 1950—Meeting of I.E.S. National Council, New York, N. Y.

October 26-27, 1950—Northeastern Regional Conference, Hotel Statler, New York, N. Y.

March 4-6, 1951 — Southwestern Regional Conference, Corpus Christi, Texas.

March 12-16, 1951 — South Pacific Regional Conference, San Francisco, Calif.

March 19-24, 1951—Pacific Northwest Regional Conference, Spokane, Wash.

April 9-10, 1951—Southern Regional Conference, Miami, Fla.

May 9-12, 1951—Canadian Regional Conference, Chateau Frontenac, Quebec.

May 14, 1951—Midwestern Regional Conference (Hotel and City not yet announced).

May 21, 1951—Great Lakes Regional Conference, Cincinnati, Ohio.

Industry Events

September 11-15, 1950—Instrument Society of America, National Conference and Exhibit, Buffalo Auditorium, Buffalo, N. Y.

September 13-15, 1950 — Northwest Public Power Association Convention, Portland Hotel, Portland, Ore.

September 18-21, 1950 — International Municipal Signal Association, 55th Annual Convention, Hotel Commodore, New York, N. Y.

September 18-22, 1950 — National Instrument Conference and Exhibit, Memorial Auditorium, Buffalo, N. Y.

September 19-21, 1950 — The American Society of Mechanical Engineers, Fall Meeting, Hotel Sheraton, Worcester, Mass.

September 25-27, 1950—National Electronics Conference, Chicago, Ill.

September 27-29, 1950 — Sixth annual meeting, Canadian Electrical Manufacturers Association, General Brock Hotel, Niagara Falls, Canada.

September 27-30, 1950—Association of Edison Illuminating Companies, Annual Meeting, The Broadmoor, Colorado Springs Hotel, Colo.

October 11-14, 1950 — International Association of Electrical Leagues, 15th Annual Conference, Copley Plaza, Boston, Mass.

October 11-14, 1950 — The Electrochemical Society Inc., 98th Meeting, Statler Hotel, Buffalo, N. Y.

October 13-14, 1950 — Electrical Inspectors Association of British Columbia, Annual Convention, Hotel Georgia, Vancouver, B. C.

October 16-20, 1950 — 38th National Safety Congress & Exposition of the National Safety Council, Chicago, Ill.

October 17-20, 1950 — National Electrical Contractors Association, Annual Convention, Hotel Biltmore, Los Angeles, Calif.

October 18-20, 1950—National Farm Electrification Conference, Melbourne Hotel, St. Louis, Mo.

October 19-21, 1950 — Institute of Power Engineers, 1950 Convention, Windsor Hotel, Montreal, Canada.

October 23-27, 1950 — American Institute for Electrical Engineers, Fall General Meeting, Skirvin Hotel, Oklahoma City, Okla.

November 13-16, 1950 — National Electrical Manufacturers Association, Chalfonte-Haddon Hall, Atlantic City, N. J.

November 26 - December 1, 1950 — The American Society of Mechanical Engineers, Annual Meeting, Hotel Statler, New York, N. Y.

November 27-29, 1950 — American Standards Association, Annual Meeting, Waldorf-Astoria Hotel, New York, N. Y.

December 3-6, 1950 — The American Society of Refrigerating Engineers, 46th Annual Meeting, Hotel Commodore, New York, N. Y.

January 29-30, 1951—Winter General Meeting, American Institute of Electrical Engineers, New York.

March 12-15, 1951 — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

April 2-5, 1951 — The American Society of Mechanical Engineers, Spring Meeting, Atlanta, Ga.

April 2-5, 1951 — 17th Annual Sales Conference, Edison Electric Institute, Edgewater Beach Hotel, Chicago, Ill.

June 4-7, 1951 — Edison Electric Institute, Denver, Colorado.

Street Lighting Recording Device

Improvements in street lighting, with a decrease in the number of night traffic accidents and fatalities, are hoped for as the result of a new light-measuring and recording device developed recently. Called the "G-E Rapid Recorder for Measuring Street Illumination," the new device consists of an "electric eye on wheels," connected by a 30-foot aluminum tube to an automobile carrying an amplifier and graphic recorder. The light-sensitive "eye," riding only six inches above pavement level, trails far enough behind the auto to have an unobstructed view of the highway lighting. The setup is said to permit the accurate measurement and recording of varying amounts of light along endless miles of roadway at the rate of ten to twenty miles per hour. This is at least 25 to 100 times faster than could be done by previous methods involving the laborious task of making separate measurements on 10-foot centers, it was said.

With the new rapid recorder, street lighting engineers estimate that the measurements which may now be taken in a single night would, by former techniques, require four months to gather.

The new development is credited to A. H. Taylor and W. G. Praecjus of the G. E. Lamp Department at its Nela Park headquarters. The new device was unveiled for the first time on May 23rd at the Great Lakes Regional Conference of the Illuminating Engineering Society in Buffalo, N Y.

Driving mechanism of the recorder is connected to the auto's speedometer cable with the result that distance traveled is accurately recorded on a six-inch paper roll of tape. This record, the engineers say, is so simple and obvious as contrasted to the complex results of the past that many additional advantages are seen. The municipal official, for example, may more quickly grasp the meaning of the study and see the need for better street lighting; safety officials may have a new "yard stick" for correlating night accident experience with the existing illumination; lighting designers may be able to determine whether lighting layouts are adequate; and, lighting equipment makers may be aided in checking their laboratory photometry against actual field results.

NIGHT view of recorder device for street lighting measurements.

New York Subway Lighting Criticized

In a recent issue of its Sunday edition, the *New York Times* took to task the lighting existing in New York City's subways — new fluorescent lighting included.

The newspaper reported that "a team of design experts, appointed by the municipal art society to study the decor of public buildings and utilities, turned in a report May 13 which sharply criticized the decorative scheme of subways, their lighting, and their advertising standards."

The Committee declared that "exposed incandescent lighting in the older subway stations is inadequate, creates shadows in some cases to a point of danger. . . . the fluorescent lighting in the newer trains of the Independent System "unfortunately" is not considered to be an improvement because of its intensity and glare."

Is this to some degree at least, another instance where a reasonably well lighted area appears to be uncomfortably over-lighted in contrast with its surroundings — in this case, the dingy subway stations!

Coal Mine Operators Sponsor Lighting Clinic

A Lighting Clinic of rather unusual nature was sponsored August 22, by the National Coal Association. While most clinics are based on "how-to," this one was held to determine "what-are" the lighting problems. Coal mine operators met at Nela Park for a frank discussion of just what coal lighting needs may be, what limitations might be involved, and what might be done to meet these problems.

G. F. Prideaux of General Electric, Nela Park, conducted the meeting. Details of the full-day meeting included:

Fundamentals of Vision by A. A. Eastman.
Bureau of Mines Resumé of Current Underground Lighting
A Report on Levels of Visibility Found in Mines Today by H. M. Ferree
Operators' Viewpoint on Mine Lighting by M. H. Forester
Inspection of Institute
"Whitewash" for Better Seeing by C. M. Crysler
Light, Safety, and Production by C. E. Egeler
Illuminating Engineering Society Cooperation by G. F. Prideaux
Tabulation of Problems to Be Solved in Improving "Seeing" Underground by Chairman and Group
Dinner

IT SEEMS TO ME

Maintenance Factor

To the Editor:

The definition of "Maintenance Factor" concerns three I.E.S. Committees: The Committee on Nomenclature, the Lighting Design Practice Committee, and the Maintenance Committee.

This term may be defined in two ways. Each definition has its proponents and advantages. It has been defined in both ways in I.E.S. publications and in industry publications.

1. The maintenance factor is the ratio of the in-service illumination level to the initial illumination level. Specifically, the maintenance factor is an allowance for

a. depreciation in lumen output of the lamp during life,
b. depreciation due to dirt on the lamps and luminaire,
c. depreciation due to gradual darkening of the room surfaces.

or

2. The maintenance factor is the ratio of the in-service flux emitted by the luminaire to the initial flux emitted by the luminaire. Specifically, the maintenance factor is an allowance for

a. depreciation in lumen output of the lamp during life,
b. depreciation due to dirt on the lamps and luminaire.

There is only one point of difference between the two definitions: Should the maintenance factor comprehend gradual darkening of room surfaces?

On the other hand it may be said that the maintenance factor should be an allowance for the depreciation of initial illumination, for any reason whatever. It simplifies the lighting problem to have

the maintenance factor include all factors contributing to the depreciation in illumination. The initial illumination level then can be calculated by leaving the maintenance factor out of the basic formula:

$$\text{Footcandles} = \frac{\text{Total Lumen} \times \text{Coefficient of Utilization}}{\text{Area}}$$

At first glance this reasoning seems logical. But further consideration reveals serious objections to including in the maintenance factor an allowance for the reduction of illumination level caused by depreciation of the reflecting qualities of the room surfaces:

1. The reduction in illumination from this cause is not a constant but varies, depending not only on the degree of darkening of room surfaces, but also on the room shape and the fixture distribution.

2. This loss in illumination is more easily and accurately accounted for by selecting the proper coefficient of utilization from the coefficient of utilization table.

The maintenance factor for a given fixture employing a given lamp, and used in a given atmosphere and subject to a specified cleaning schedule, should be a constant. But it cannot be a constant if the depreciation in illumination due to darkening of room surfaces is introduced into the maintenance factor, because this decrease varies with the room index. For example, the coefficient of utilization for the bottom fixture on page 8-11 of the I.E.S. Handbook for a 75% ceiling and 50% wall reflectance is .15 for a "J" room. If the walls depreciate to 30% reflectance, the coefficient of utilization is .11 — a reduction of 27% in the illumination level. In an "A" room the coefficients are .43 for 50% wall reflectance and .41 for 30% wall reflectance, only 5% less illumination for the same reduction in wall reflectance. Hence, under this system the maintenance factor for a given installation would depend on the proportions of the room. That is illogical.

The definition of the coefficient of utilization is not altered by this arrangement. The definition merely applies during the "in service" period rather than only in the beginning.

The I.E.S. has just set up a Maintenance Committee to draw up rules that can eventually lead to the establishment of reasonably accurate data on the depreciation of illumination.

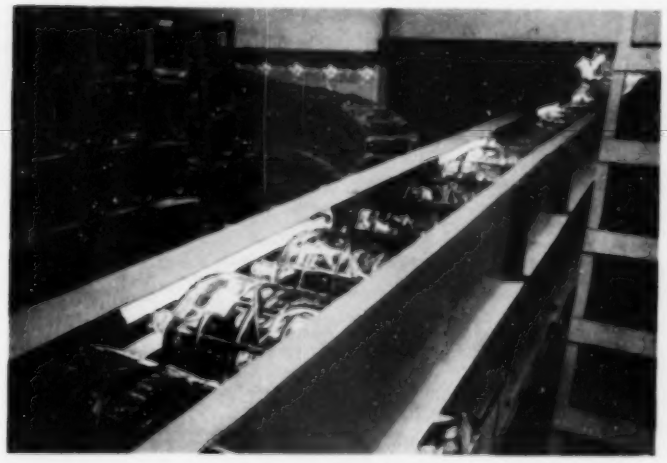
This Committee will undoubtedly gather data or outline rules for collecting relatively accurate information on:

1. Loss of illumination due to the aging of lamps (already available from the lamp manufacturers for most lamps).

2. Loss of illumination due to dirt collected on lamps and fixtures in various atmospheres for various periods of time.

We would like to have this Committee also tell us how much our lighting level will fall off because of dirt on the walls and ceilings. But they can't because this will depend on the room shape and on the candlepower distribution curve of the fixture. The Committee could, however, tell us how much reflectance of room surfaces will be reduced for various paints over a period of time. It would then be very simple to use this information to select the proper coefficient from the coefficient of utilization table.

It is important the definition of the maintenance factor be made clear, in order to assist the lighting engineer obtain as much accuracy as possible. At best, the maintenance factor is, at present, the weak link in our method of making lighting calculation. — J. R. JONES, *Westinghouse Electric Corporation, Bloomfield, N. J.*



BACTERICIDAL Lamps safeguard the purity of Sparkletts artesian spring water as it is being bottled, in Los Angeles, Calif. Twenty long tubular bactericidal lamps are installed on the main production line to cover every step of the production where bottles or water are exposed to the air. In addition, 20 similar lamps are used in a specially-designed cylindrical sterilizer through which the water passes for a final intensive sterilization just before going into the sterilized bottles.

BOOKS AND PAMPHLETS

"The American Economic System," by Frank D. Newbury, published 1950 by McGraw-Hill Book Company, New York, N. Y.: 548 6 x 9-inch pages, illustrated; $5.00.

As a former director, vice-president and economist for the Westinghouse Corporation, Mr. Newbury speaks from a very substantial foundation of first-hand experience and observations. He has put between the pages of this new book a surprisingly complete summary of his down-to-earth, feet-on-the-ground knowledge of economics. A quotation from the foreword will indicate his philosophy: "This book is dedicated to all students wherever they may be — in school, in business, or in organized labor — who desire deeper understanding of the powerful, dynamic, restless economic system which is our American heritage. With understanding there can be greater progress and more stability; without understanding, there may be stagnation, decay, or even destruction of this system for which we are all responsible."

In Chapter 1, Mr. Newbury sets forth the five basic principles of the American system: (1) the institution of private property; (2) the institution of the private business firm; (3) the maximum individual freedom of choice; (4) the ideal of effective and fair competition; (5) the principle of rewards proportionate to contribution. Part 1

Continued on page 24A

SUSTAINING MEMBERS

Acme Electric Corp.
Cuba, N. Y. *J. A. Comstock*

Advance Transformer Co.
1122 W. Catalpa Ave., Chicago 40, Ill.
Hirsch Epstein

Alabama Power Co.
Birmingham, Ala. *George L. Morris*

All Bright Electric Products Co.
3917-25 N. Kedzie Ave., Chicago 18, Ill.
Max Klein

Aluminum Company of America
Gulf Building, Pittsburgh 19, Pa.
C. Braglio

Amalgamated Electric Corp., Ltd.
884 Pape Ave., Toronto, Ont., Canada
D. W. Patterson

American Concrete Corp.
4727 North Lamon Ave., Chicago 30, Ill.
J. W. Lewis

American Fluorescent Corp.
8407 Broadway, Chicago, Ill. *William Eisenak*

American Startliner Co.
Erie, Pa. *Horace Wm. Alexander*

Appleton Electric Co.
1701-1730 Wellington Ave., Chicago 13, Ill.
Nils A. Tornblom

Arkansas Power & Light Co.
Simmons National Bldg., Pine Bluff, Ark.
Max Huddleh

The Art Metal Co.
1814 E. 40th St., Cleveland 3, Ohio
George E. Glatthar

Artistic Lamp Manufacturing Co., Inc.
895 Fourth Ave., New York 16, N. Y.
Myron Perlmutter

Bausch & Lomb Optical Co.
Rochester 2, N. Y. *Arthur E. Neumer*

Benjamin Electric Mfg. Co.
Des Plaines, Ill. *John H. Waterbury*

Blue Ridge Glass Corp.
P.O. Box 631, Kingsport, Tenn.
James Herbert

Board of Water and Electric Light Commissioners
116 W. Ottawa St., P.O. Box 570, Lansing 4, Mich. *John D. Mulnight*

Boston Edison Co.
39 Boylston St., Boston 13, Mass.
R. B. Brown, Jr.

Branham, Marsek & Duepner, Inc.
7020 Walker St., St. Louis Park, Minneapolis 16, Minn. *Cecil H. Branham*

Bright Light Reflector Co., Inc.
Fairfield & State, Bridgeport 5, Conn.
C. E. Scholl

British Columbia Electric Rwy. Co., Ltd.
570 Dunsmuir St., Vancouver, B. C., Canada
H. N. Walters

Brockton Edison Co.
98 Main St., Brockton 67, Mass.
W. A. Forbush

Edward F. Caldwell & Co., Inc.
101 Park Ave., New York 17, N. Y.
E. T. Caldwell

California Electric Power Co.
P.O. Box 513, Riverside, Calif.
W. E. Vaughn, Jr.
Ralph G. Raymond

Cal-Lite, Inc.
12600 S. Yukon Ave., Hawthorne, Calif.
E. L. Urales

Calpa Products Co.
4116 Chester Ave., Philadelphia 4, Pa.
Paul C. Colisti

Cambridge Electric Light Co.
46 Blackstone St., Cambridge 39, Mass.
Reginald H. Bowman

Canadian General Elec. Co., Ltd.
212 King St., Toronto, Ont. *R. M. Love*

Canadian Laco Lamps, Ltd.
745 Guy St., Montreal, Que. *J. Thomas*

Canadian Line Materials, Ltd.
Postal Station H, Toronto 13, Ont., Canada
L. E. Messinger

Central Hudson Gas and Elec. Corp.
50 Market St., Poughkeepsie, N. Y.
H. E. Dexter

Central Illinois Light Co.
316 Jefferson Ave. S., Peoria 2, Ill.
R. K. Dallas

Central Illinois Public Service Co.
607 E. Adams St., Springfield, Ill. *R. L. Palm*

Central Maine Power Co.
9 Green St., Augusta, Maine *Roland W. Hoar*

Central Power & Light Co.
P.O. Box 2121, Corpus Christi, Texas
James M. Williams

Champion Lamp Works Div. of Consolidated Electric Lamp Co.
600 Broad St., Lynn, Mass. *Ellery H. Raddin*

Cincinnati Gas & Electric Co.
Fourth & Main Sts., Cincinnati 1, Ohio
J. E. Hartman

Circlite Corp.
118 So. Clinton St., Chicago, Ill.
George Gomberg

City of Burbank, California Public Service Department
174 W. Magnolia Boulevard, Burbank, Calif.
J. H. McCambridge

City of Glendale Public Service Dept.
119 N. Glendale Ave., Glendale 6, Calif.
H. E. Gulick

City of Riverside Electric Light Dept.
3834 Mulberry St., Riverside, Calif.
L. W. Grayson

City of Seattle, Dept. of Lighting — Puget Sound
1015 Third Ave., Seattle 4, Wash.
P. C. Spowart

City of Tacoma, Light Division
402 City Hall, Tacoma 2, Wash.
Roy H. Weston

The Cleveland Electric Illuminating Co.
75 Public Square, Cleveland 1, Ohio
R. C. Hienton

Colonial Electric Products Co., Inc.
1-115 Market St., E. Paterson, N. J.
Wallace M. Woodworth

Colonial Premier Co.
466 W. Superior St., Chicago 10, Ill.
Richard Weis

Columbia Electric & Mfg. Co.
1024 West Ide Ave, Spokane, Wash.
Walter A. Toly

Commercial Light Co.
841 W. Washington Blvd., Chicago, Ill.
Michael R. Pino

Commonwealth Edison Co.
72 W. Adams St., Chicago 90, Ill.

The Connecticut Light & Power Co.
250 Freight St., Waterbury 91, Conn.
James H. Dook

Consolidated Edison Co. of N. Y., Inc.
4 Irving Place, New York 3, N. Y.
Thomas J. Collins

Consolidated Gas, Elec. Light & Power Co. of Baltimore
100 W. Lexington St., Baltimore 1, Md.
M. C. Albrittain

Consumers Power Co.
212 Michigan Ave. W., Jackson, Mich.
D. E. Karn

Consumers Public Power Co.
1452-25th Ave., Columbus, Nebraska
W. H. Sinks

Corning Glass Works
Corning, N. Y. *A. S. Tyler*

Coyne Electrical School, Inc.
500 So. Paulina St., Chicago 7, Ill.
John Hanon

Crescent Electric Supply Co.
765 Iowa St., Dubuque, Iowa
Titus B. Schmid

Crouse-Hinds Co.
Syracuse 1, N. Y. *A. H. Clarke*

Crouse-Hinds Co. of Canada, Ltd.
7 Labatt Ave., Toronto, Ont. *F. R. Jaffery*

Curtis Lighting, Inc.
6135 W. 65th St., Clearing Station, Chicago 38, Ill. *Darwin Curtis*

Curtis Lighting of Canada, Ltd.
195 Wicksteed Ave., Leaside, Toronto 12, Ont. *H. L. Wright*

Cutler Light Manufacturing Co.
3026-28 N. 22d St., Philadelphia 21, Pa.
Robert T. Cutler

Dallas Power & Light Co.
1506 Commerce St., Dallas 1, Texas
W. G. Moore

Day-Brite Lighting, Inc.
5401 Bulwer St., St. Louis 7, Mo.
D. J. Biller

The Dayton Power & Light Co.
25 No. Main St., Dayton, Ohio
H. S. Nonneman

Dazor Manufacturing Corp.
4483 Duncan Ave., St. Louis 10, Mo.
P. L. Read

Delaware Power & Light Co.
600 Market St., Wilmington 99, Del.
W. A. F. Pyle

Dept. of Water & Power, City of Los Angeles, Bur. of Power & Light
Box 3669 Terminal Annex, 207 So. Broadway, Los Angeles 54, Calif. *C. P. Gorman*

Detroit Edison Co.
2000 Second Ave., Detroit 26, Mich.
L. E. Taylor

Detroit Electrical Contractors Association
627-628 Hotel Book Cadillac, Detroit 26, Mich.
Carl J. Schoeniger

Detroit Steel Products Co.
2250 E. Grand Blvd., Detroit 11, Mich.
W. Clifton Randall

E. I. duPont de Nemours & Co., Inc. (Fabrics & Finishes Div.)
Wilmington 98, Del. *S. W. Quisenberry*

E. I. du Pont de Nemours & Co., Inc. Polychemicals Dept.
Wilmington 98, Del. *R. E. Leary*

Duquesne Light Co.
435 Sixth Ave., Pittsburgh 19, Pa.
G. W. Ousler

Duro Test Corp.
2321 Hudson Blvd., North Bergen, N. J.
James L. Cox

Eastern Fixture Co., Inc.
170 Vernon St., Boston 20, Mass.
Louis Gilman

(*Note*: Names of Official Representatives appear in Italics)

East Side Metal Spinning & Stamping Corp.
1301 Elizabeth Ave., W., Linden, N. J.
M. A. Kremer

Ebasco Services, Inc.
2 Rector St., New York 6, N. Y.
P. D. Brooks

Electrical Information Publications, Inc.
20 E. Mifflin, P.O. Box 232, Madison, Wis.
W. N. Dudley

Electrical Testing Laboratories, Inc.
79th St. & East End Ave., New York City 21, N. Y.
W. F. Little

Elec. Service Mfg. Co.
17th & Cambria Sts., Philadelphia 32, Pa.
J. W. Schmidt

Electro Manufacturing Corp.
2000 W. Fulton St., Chicago 12, Ill.
L. K. Schoenbrod

Electrolier Mfg. Company, Ltd.
5849 Boyer St., Montreal, Que., Canada.
John Isenman

Ender Manufacturing Corp.
360 West St., New York 13, N. Y.
Jules Levenstein

Electron Corp.
4501 Galapago, Denver, Colo. *Floyd Vickers*

Englewood Electrical Supply Co.
5801-03 So. Halsted St., Chicago, Ill.
Ray O'Leary

Famous Fluorescent Light Co.
702 N. Ogden Ave., Chicago 22, Ill.
Jack R. Stone

Federal Electric Company, Inc.
8700 S. State St., Chicago, Ill.
John H. Gochet

Fitchburg Gas & Electric Light Co.
537 Main St., Fitchburg, Mass. *A. G. Neal*

Fluorescent Equipment & Mfg. Co.
2570 Superior Ave., Cleveland 14, Ohio
Leonard S. Freeman

Fluorescent Maintenance Co., Inc.
1480 S. Robertson Blvd., Los Angeles 35, Calif. *Leonard E. Black*

Fluores-O-Lite Co.
Evans Terminal, No. Broad St., Hillside, N. J.
Meyer H. Silverman

The Fostoria Pressed Steel Corp.
Fostoria, Ohio *E. L. Bates*

H. A. Framburg & Co.
3320-38 Carroll Ave., Chicago 24, Ill.
Stanley A. Framburg

The France Mfg. Co.
10325 Berea Rd., Cleveland 2, Ohio
J. H. Mayne

The Frankelite Co.
1435 Rockwell Ave., Cleveland 14, Ohio
Dave Frankel

Franklin Design Service, Division of Safeway Stores, Inc.
4th & Jackson Sts., P.O. Box 660, Oakland 4.
Wallace H. Lane

The Frink Corporation
27-01 Bridge Plaza North, Long Island City, N. Y. *Theo. J. Brussel, Jr.*

Gallagher-O'Brien Electric Co., Inc.
712 N. State St., Chicago 10, Ill.
Frank A. Gallagher

Garden City Plating & Mfg. Co.
1750 No. Ashland Ave., Chicago 22, Ill.
G. G. Harney

General Electric Co., Apparatus Dept.
River Works, 920 Western Ave.,
West Lynn, Mass. *A. F. Dickerson*

General Electric Co., Lamp Dept.
Nela Park, Cleveland 12, Ohio
Willard C. Brown

General Electric Supply Corp.
1260 Boston Ave., Bridgeport, Conn.
W. W. Booth

General Lighting Products Co.
468 Frelinghuysen Ave., Newark 5, N. J.
Nathan H. Eglowstein

General Outdoor Advertising Co., Inc.
515 So. Loomis St., Chicago, Ill. *E. E. Nevins*

The Georgia Power Co.
Electric Building, Atlanta 1, Ga.
Charles A. Collier

Gibson Manufacturing Co.
1919 Piedmont Circle, N. E., Atlanta, Ga.
E. E. Gibson

Gill Glass & Fixture Co.
Amber & Tioga Sts., Philadelphia 34, Pa.
C. A. Gill

Gillinder Brothers, Inc.
Erie & Liberty Sts., Port Jervis, N. Y.
J. Fletcher Gillinder

Gleason-Tiebout Glass Co.
59-59 54th St., Maspeth, N. Y.
Charles W. Gleason

Globe Lighting Products Co., Inc.
397 Seventh Ave., Brooklyn, N. Y.
Isidor Rosenblatt

Godfrey and Wing, Inc.
3141 Superior Ave., Cleveland 14, Ohio
C. G. Wing

Golde Manufacturing Co.
1214 West Madison, Chicago 7, Ill.
E. W. Goldberg

Grand Rapids Store Equip. Co.
1340 Monroe Ave., N. W., Grand Rapids 3, Mich. *Kenneth C. Welch*

Graybar Electric Co., Inc.
420 Lexington Ave., New York 17, N. Y.
Raymond C. Kinney

Gulf States Utilities Co.
Box 2951, Beaumont, Texas *Clarence Barron*

The Edwin F. Guth Co.
2615 Washington Ave., St. Louis 3, Mo.
Fred E. Guth

The Hankins Container Co.
3044 W. 106th St., Cleveland 11, Ohio
Ray T. White

Hartford Electric Light Co.
266 Pearl St., Hartford 3, Conn.
Victor Ouellette

Hawkins Electric Co.
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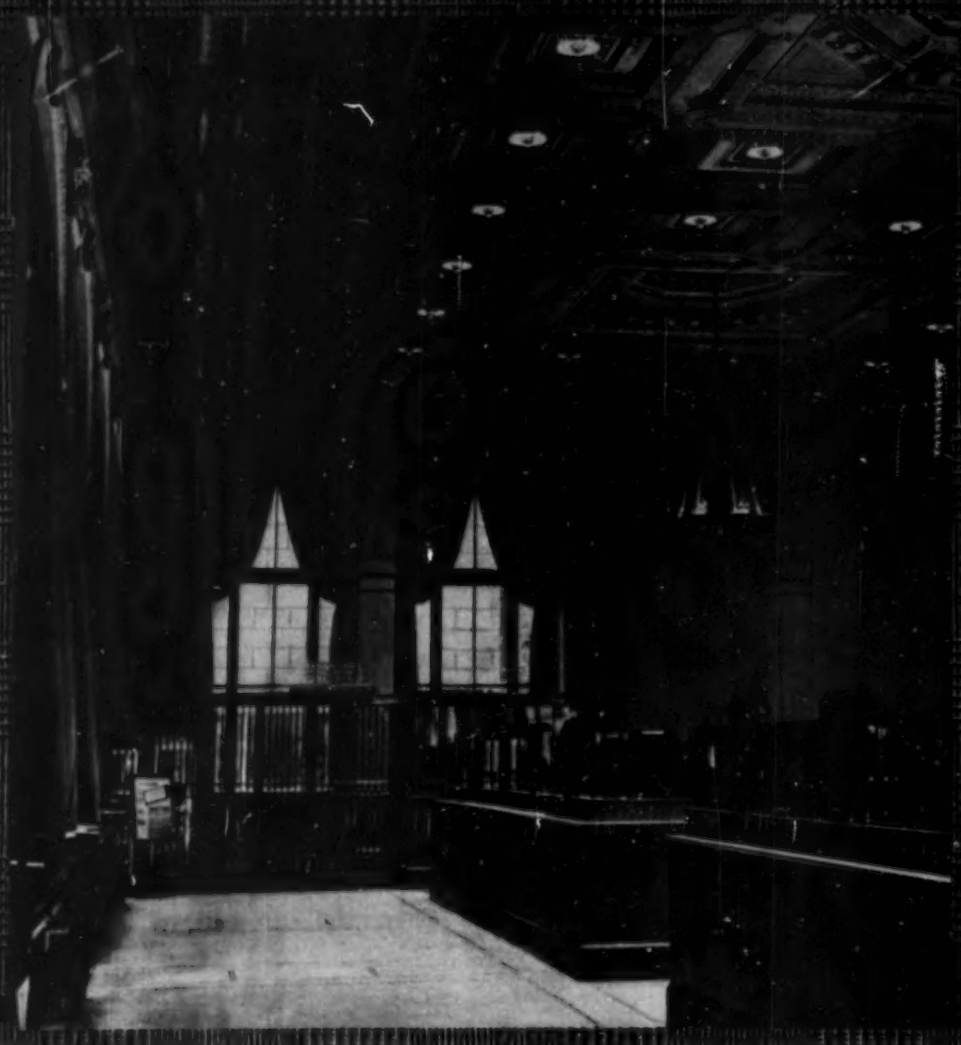

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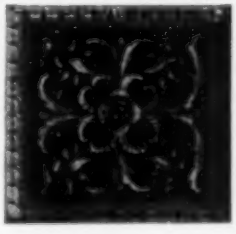
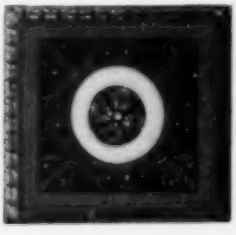


Before: Detailed view of original ceiling section.



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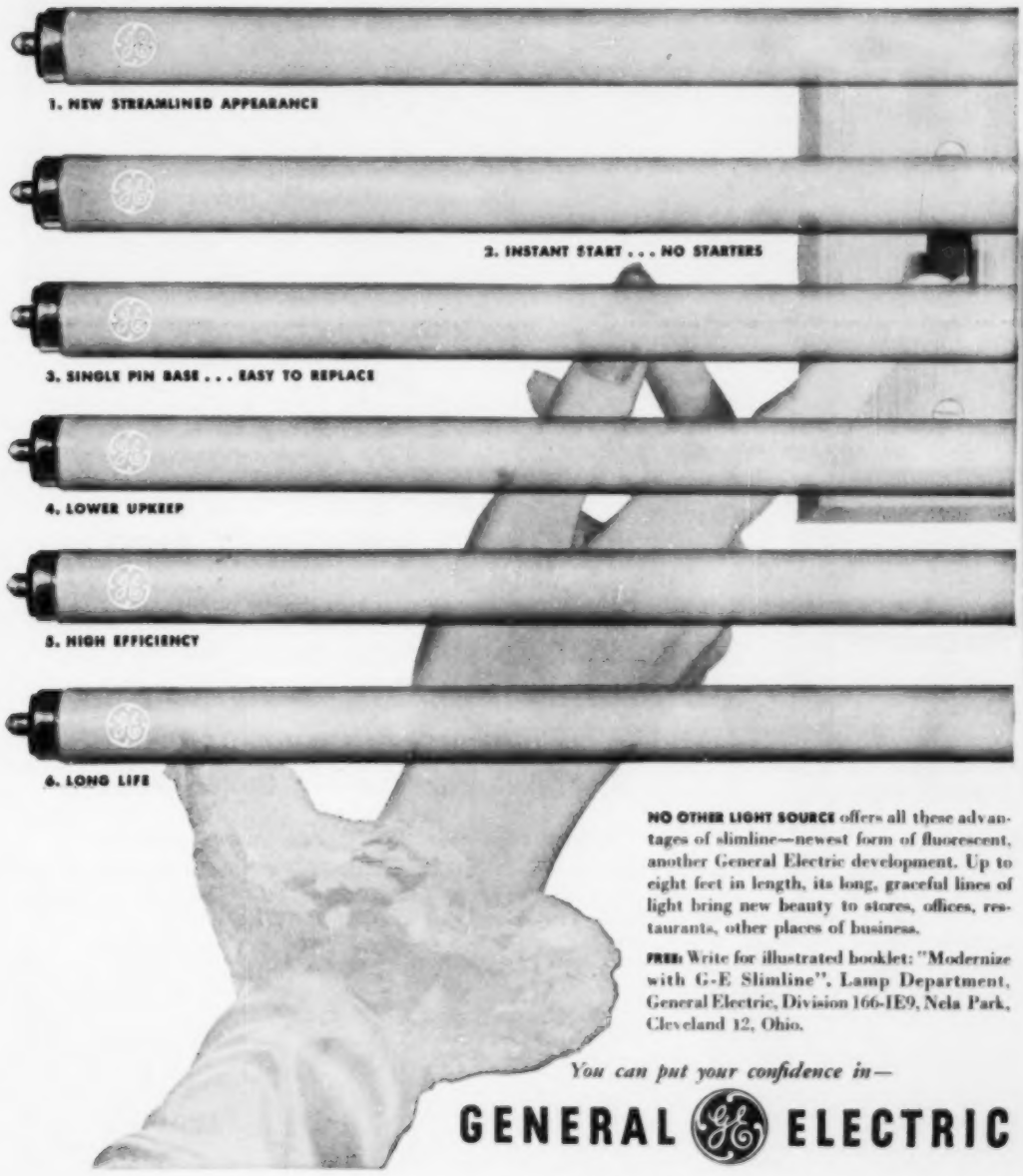
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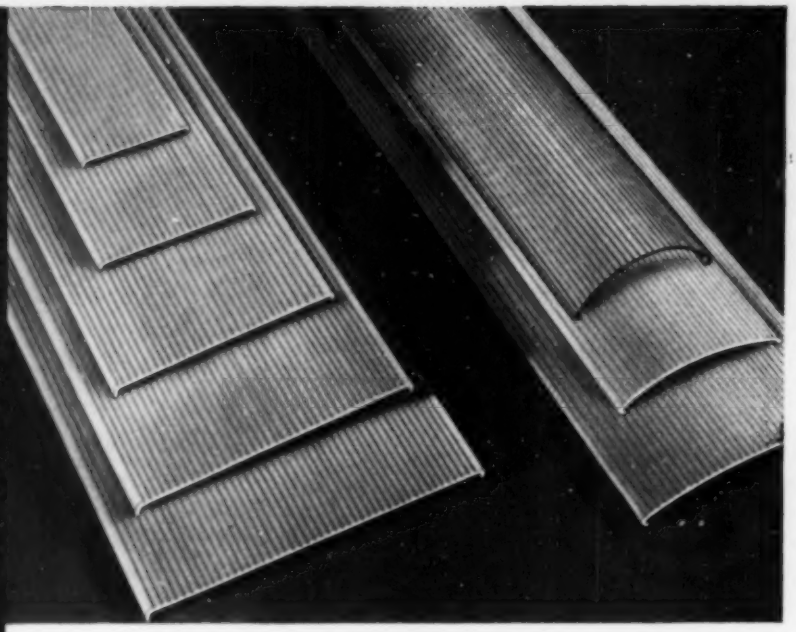

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"Pittsburgh" Permaflector

TWO NEW 48" and 96" SLIMLINE LUMINAIRES

THE "WASHINGTON" SLIMLINE LUMINAIRE features an egg-crate louver bottom and Skytex satinal glass side-panels. It is made in 2, 3 and 4 lamp models. Standard operation is 425-MA with T-12 Lamps. Bridge-truss construction assures a unit which "hugs" the ceiling when it is surface mounted.

THE "HARRISON" SLIMLINE LUMINAIRE, in 2, 3 or 4 lamp models. Gracefully curved side-panels, flat bottom-panels of Alba-Lite glass distinguish this modern slimline luminaire. Companion incandescent units are designed especially for use with the "Harrison" and other Presidential Fluorescent Luminaires.

The flexibility of Pittsburgh Permaflector Lighting Equipment is a modern miracle of design and construction.

For example—Pittsburgh Permaflector Slimline Luminaires are available in 48" and 96" lengths. They may be surface or pendant mounted, individually or end-to-end. When used with companion incandescent down-lights, they can be installed to form squares, rectangles, "T's", cross-overs, checkerboards and other patterns.

Such flexibility allows you full creative expression and makes possible "custom designed" lighting results with economical *standard* equipment.

Write today for more information on these versatile units.

PITTSBURGH REFLECTOR COMPANY

411 OLIVER BUILDING • PITTSBURGH 22, PENNSYLVANIA

MANUFACTURERS OF FLUORESCENT & INCANDESCENT LIGHTING EQUIPMENT

Permaflector Lighting Engineers in All Principal Cities

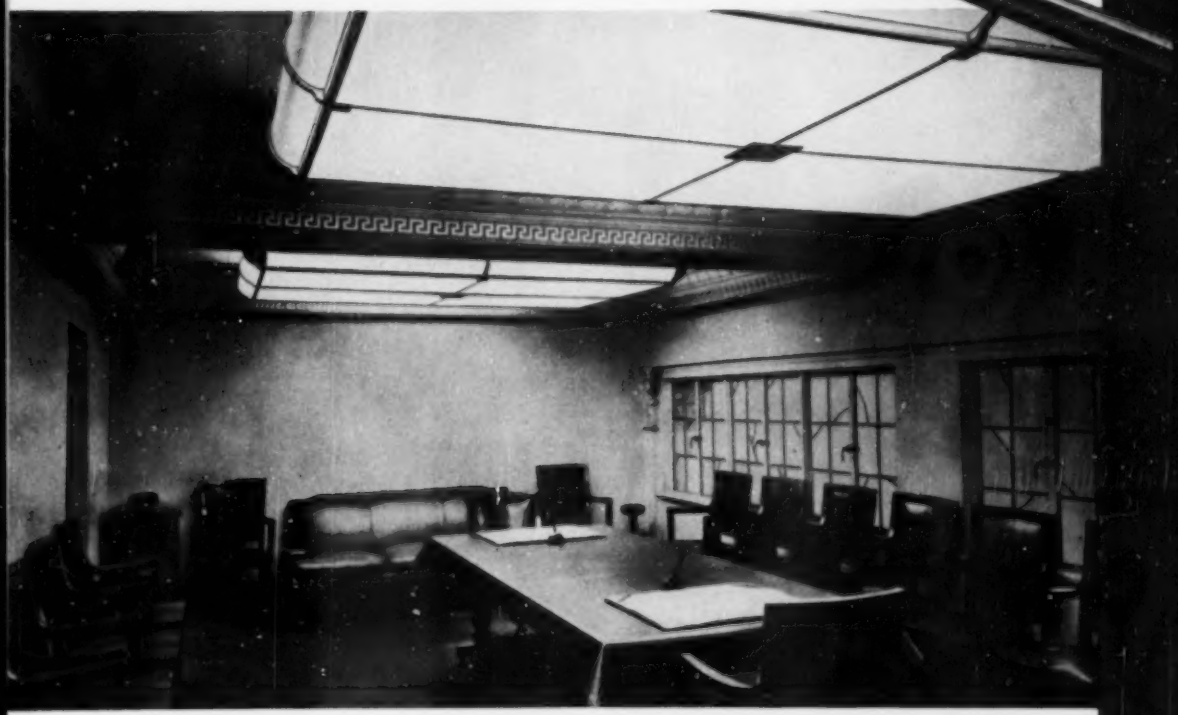
"the Board of Directors unanimously

No wonder PLEXIGLAS lighting wins approval. It provides glarefree, shadowless illumination wherever installed, from Directors' Rooms to housewives' kitchens. The full output of the lighting source is evenly diffused across the surface of this highly efficient acrylic plastic. Result: A luminous atmosphere notable for low brightness contrast and high visibility.

PLEXIGLAS aids design and installation, too. Lightness and strength mean easy erection with fewer, lighter supports. Resistance to breakage and discoloration assures low-cost maintenance. And the variety of translucency-grades in flat, patterned, or corrugated material, coupled with the ability of PLEXIGLAS to be formed readily and economically to almost any desired shape, gives almost unlimited scope to fixture design.

◀ PLEXIGLAS is used for both diffusion and reflection of light in the General Electric Company Board of Directors' Room, New York City. White translucent panels in the 9-foot-square fixtures diffuse perfectly the light from 18 Slimlines mounted only 2¼" from the acrylic plastic surfaces. Lightly sanded on the outside, the panels also act as diffuse reflectors for indirect lighting from hanging fixtures that are used when the main lighting is not needed. Fixtures designed and installed by The Frink Corporation, Long Island City, New York.

approved the New PLEXIGLAS Lighting..."



PLEXIGLAS ceiling lighting fixtures in the Directors' Room of Cleveland's Bank of Ohio produce an average illumination of 75 footcandles on the conference table. Each fixture measures approximately 6 x 8 feet and consists of four corrugated bottom diffusing panels with curved side panels formed from 12" strips of flat material. Ten 96" 300MA G.E. Slimline and two 40-watt fluorescent lamps (mounted at right angles at the ends of the Slimlines) illuminate each fixture. All lamps are 3000°. Fixtures installed by Bell Electric Company. Design consultants: W. E. Conley, General Electric Co.; John Liston, George S. Rider Co.; W. A. Mize, Cleveland Electric Illuminating Company.

TELL US ABOUT YOUR PROBLEM

We will be glad to work with you on specific lighting applications. Write us today. Let us show you how PLEXIGLAS can provide the best answer to your lighting problem.

PLEXIGLAS is a trade-mark, Reg. U. S. Pat. Off. and in principal foreign countries.

CHEMICALS FOR INDUSTRY

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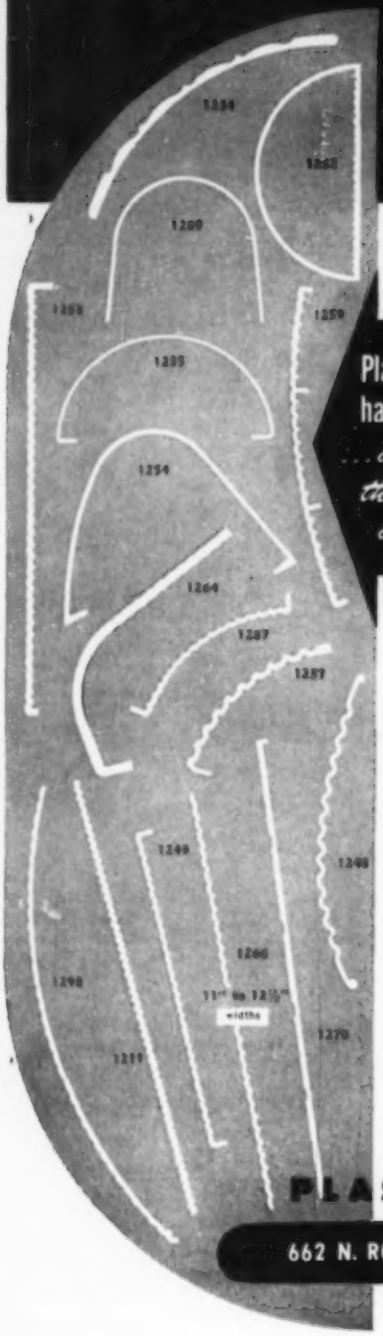

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ECONOMIZE and speed up production with PLASTIC PROCESS ready-to-use sections.

A large variety of smartly designed sections — with contours, shapes and dimensions that are flexible enough to meet any problem of size or light transmission and diffusion.

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A compact, convenient "file" of 3-inch sections in a permanent, attractive box plus our complete catalog. Indispensable as a reference for design engineers or manufacturers.

We shall be pleased to have our engineering staff cooperate in designing parts to your specific requirements. We serve manufacturers in all parts of the U. S. — prices quoted delivered to your plant.

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DAY-BRITE
Lighting Fixtures

OFFERS YOU AMAZING NEW FLEX-ABILITY

Premium quality without Premium cost

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053

Imagine your possibilities with Plexoline! New beauty . . . new patterns . . . a whole new world of lighting ideas made possible through Day-Brite's versatile Plexoline. An ingenious system of linear sections and curved accent units, Plexoline permits truly unlimited fluorescent lighting possibilities at mass production costs. And the famous Day-Brite quality delivers unequaled performance plus low-cost installation and maintenance.

But to realize all the advantages Plexoline offers you, get the full Plexoline story.

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Firm_____ Position_____

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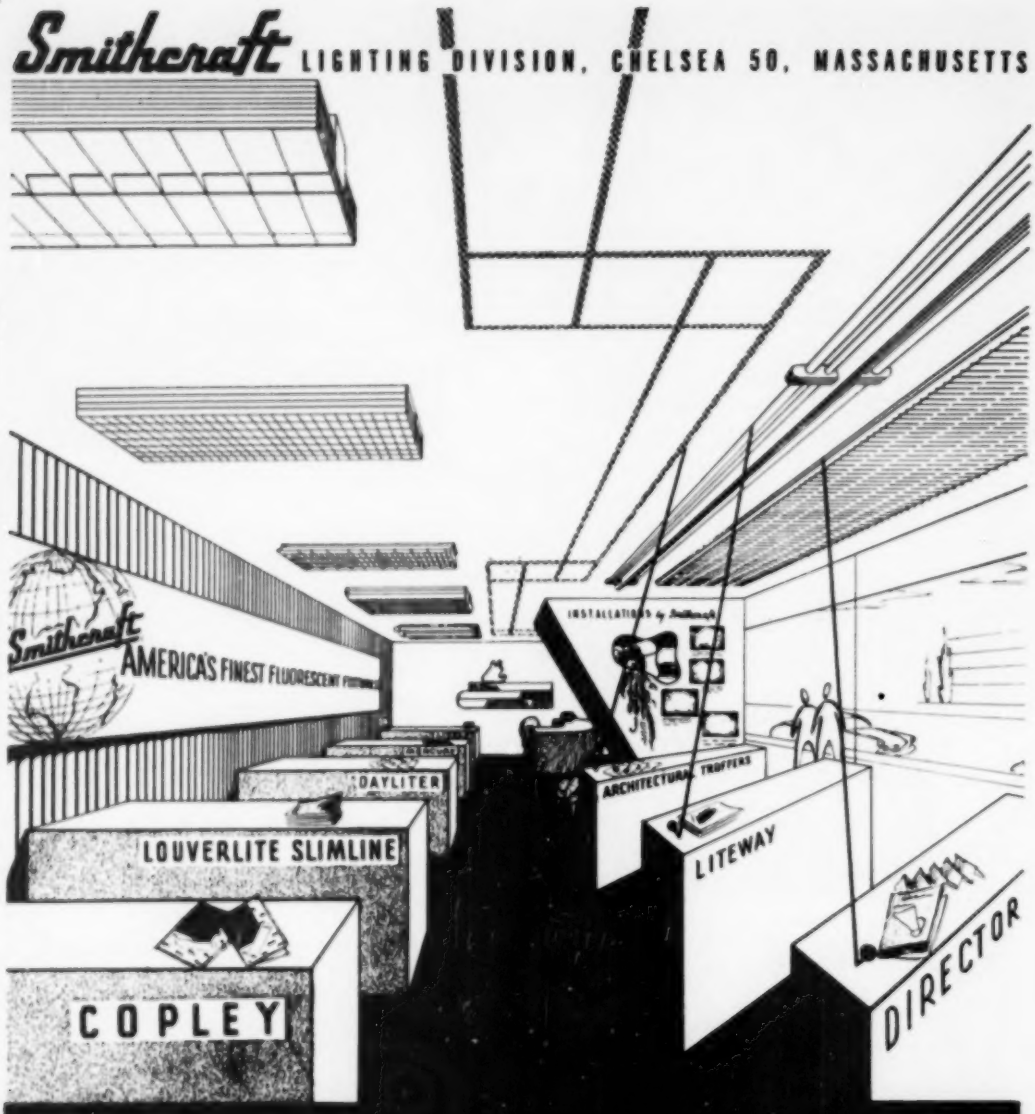

There is a Smithcraft fluorescent fixture for virtually any type of installation . . . more than 40 outstanding lighting fixtures, incorporating exclusive and important features . . . more than 500 variations for Bi-Pin and Slimline lamps. And every Smithcraft fixture is quality-designed and manufactured . . . guaranteed to provide a long-term lighting investment. This means that the purchaser can select the *right* fixture for a specific location, with the assurance of optimum lighting performance from the entire Smithcraft line.

The new Smithcraft Price Catalog is now available. It illustrates and describes all Smithcraft commercial and industrial fixtures... an informative and helpful "working" tool. Write for your copy today!

Holophane Provides the Most Effective OUTDOOR LIGHTING .... for All Production and Security Purposes

Holophane has designed a specific unit for each phase of outdoor lighting, such as:

- Airport Loading Areas
- Blast Furnaces
- Cat Walks
- Coal Conveyors
- Craneways
- Doors
- Entrances, Exits
- Fences
- Gates
- Hangar Aprons
- Oil Refineries
- Outdoor Boilers
- Outdoor Storage
- Parking Lots
- Protective Lighting
- Roadways
- Shipping Platforms
- Sub-stations
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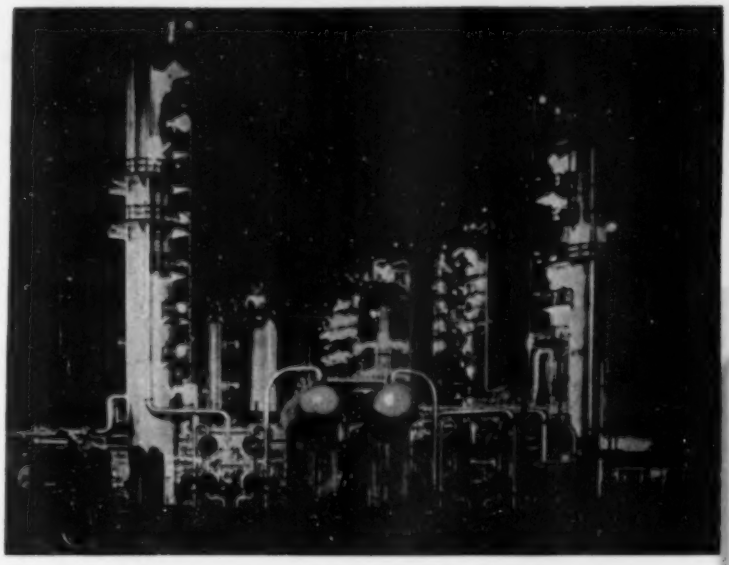
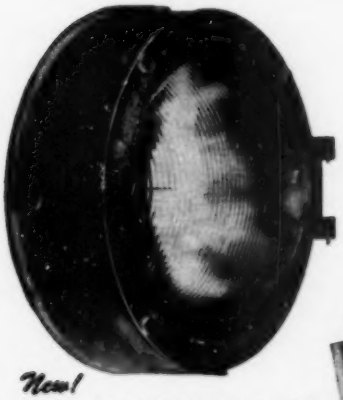
- Underpasses



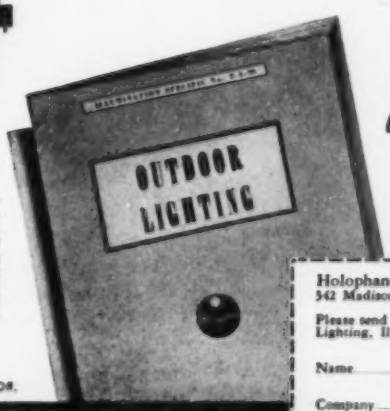


New!

1000 watt *Refractolens*® UNIT No. U-850. Ideal for a wide variety of outdoor locations. May be mounted against wall or recessed. Refracts the light downward at about 65° and spreads it laterally through 180°. For uniform illumination, space about four times the height above ground. This Refractolens unit is built to withstand heat, shock and weather. Rugged cast aluminum alloy housing has hinged door for access to lamp.

*Reg. U. S. Pat. Off.

Write for the Latest Holophane Book on Outdoor Lighting . . . This important publication backed by 50 years of experience in the field, gives authoritative information and recommendations as to the units best suited for any particular application. It also includes diagrams and practical suggestions on spacing, mounting height, footcandles and other pertinent data.



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Write today for your copy of "Outdoor Lighting". There is no obligation. Send the coupon.

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Please send me, without charge, your book on Outdoor Lighting, Illumination Specific 5-5-50.

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Company _____

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THE HOLOPHANE COMPANY, LTD., THE QUEENSWAY, TORONTO 14, ONTARIO

New Mutual Life Building Features

Modern office design requires efficiency, beauty and economy in lightingware. To achieve these ends Corning ALBA-LITE and FOTA-LITE were selected for the new Mutual Life Building in New York. With each type offering its own advantages, both contribute high level, glareless illumination while adding to decorative harmony.

If you are concerned with specifying lighting, whether for stores, offices, schools or other public buildings, it will pay you to investigate Corning ALBA-LITE and FOTA-LITE. You will see for yourself why so many others have found that they offer the ideal solution to many lighting problems.

MUTUAL LIFE BUILDING, NEW YORK CITY

Architects: Shreve, Lamb and Harmon Associates
Electrical Engineers: Clark, McMullen and Riley
General Contractors: Turner Construction Company
Fixture Manufacturers: Frink Corporation, Sylvania Electric Products, Inc. (for their own offices).
Electrical Contractors: Lord Electric Company, Inc.
Glass: Corning ALBA-LITE and Corning FOTA-LITE.

FOR EFFICIENT ATTRACTIVE LIGHTING

Twenty-two of the twenty-five floors are equipped with Corning ALBA-LITE glass in recessed troffers. Parts of the three remaining floors are equipped with Corning FOTA-LITE.

Corning Alba-Lite and Fota-Lite

Advantages of Corning FOTA-LITE

A remarkable new lighting medium, Corning FOTA-LITE is flat glass with white diffusing louvers permanently embedded by a photographic process—over 100 louvered cells per square inch! The 45° cut-off is contained within the thickness of the glass ($\frac{1}{17}$"), instead of with bulky louvering materials requiring costly maintenance.

With Corning FOTA-LITE, vertical light is effectively transmitted by the glass, while the diffusing louvers eliminate glare at cut-off area. Fixtures can be made shallow and dust-tight. Strong, light in weight and free of warpage, FOTA-LITE has unlimited applications in recessed or pendant lighting fixtures, continuous row or complete luminous ceilings. Sample on request.

A few of the 189 fixtures in the executive offices of Sylvania Electric Products, Inc. that are equipped with Corning FOTA-LITE in this building.

It is significant that Sylvania Electric Products, Inc., one of the leading manufacturers of lighting equipment selected Corning ALBA-LITE and FOTA-LITE for some of its executive offices in the Mutual Life Building.

Advantages of Corning ALBA-LITE

Corning ALBA-LITE has long been recognized for its qualities of diffusion and brightness control. With an efficiency of more than 90%, even light transmission and low panel brightness, ALBA-LITE is a thin opal that is adaptable to almost any fluorescent installation.

Available in many bends as well as flat sheets, ALBA-LITE affords unlimited design flexibility. It will not warp, discolor or scratch. Easily cleaned, it does not retain finger prints and resists weathering. Widths up to 24", lengths up to 100". It may be used in fixtures or glass ceilings as required. Send for Bulletin LS-17 which describes this versatile lighting glassware.

One of the 22 floors of the Mutual Life Building completely equipped with Corning ALBA-LITE in recessed troffers.

PYREX

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Corning means research in Glass

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Please send ☐ complete information on Corning ALBA-LITE.
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New! 200 M.A. BALLASTS

SMALLER: The famous SOLA Sequenstart design greatly reduces bulk and weight. Decreases fixture weight, cuts shipping costs and installation expense.

COOLER: Maximum heat rise, 35° C. or less (thermo-couple measurement). SOLA Sequenstarts are the only ballasts with ventilated capacitor compartments. Cooler operation reduces air conditioning load and prolongs ballast life.

MORE VALUE: All SOLA Ballasts are guaranteed for one year. In addition to the significant saving on *original* cost, these extra values save many dollars on *operating* costs: less watts loss . . . more lumens/watt . . . lumen output varying less than ±2.5% regardless of line voltage fluctuations of ±15%.

COMPLETE RANGE: Four brand new ballasts, including two new Sequenstart Ballasts, have been added to the SOLA line. These new Sequenstarts bring the advantages of the SOLA Sequenstart principle to any installation.

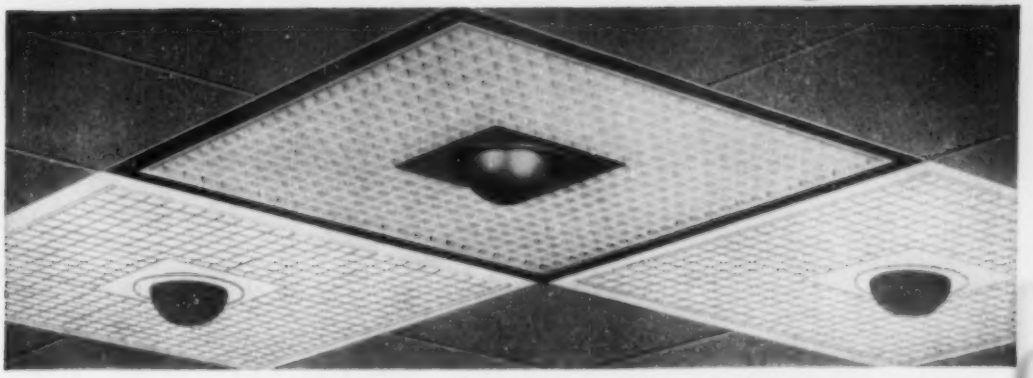
Made under one or more of the following patent Nos. 2,143,745; 2,212,198; 2,340,421; & Patents Pending.

For full data on the SOLA "Sequenstart" Ballasts write to Department C.

SOLA *"sequenstart"* *Constant Wattage* **BALLASTS**

ENGINEERING LEADERSHIP 20 YEARS

Now-a new kind of Lighting



...with all the advantages of incandescent

Plus the modern appearance of fluorescent! SILVRAY

Skylike*

The SKYLIKE system brings you a new *concept* of lighting . . . makes it possible for you to offer your commercial customers something dramatically different, better—and lower-cost! In addition to superior-quality illumination for seeing and for selling--and other features of strong appeal to *users*—SKYLIKE has the *contractor* advantages of simple wiring, light weight and fast installation, and complete freedom from service call-backs.

In fact, this new adaptation of silvered-bowl incandescent lighting provides a combination of important practical advantages not found in any other lighting system:

1. **High initial and maintained light output.**
2. **Softly diffused shadows.**
3. **Low brightness and 90° shielding.**
4. **No flickering, blinking, or hum.**
5. **Warm color—most desired by merchandising experts.**
6. **Instant starting.**
7. **Variable lamp size—150- to 500-watt.**
8. **No light loss from darkened walls or ceilings.**
9. **Floor-service relamping—no ladders or scaffolds.**
10. **Hermetically sealed silver reflecting surface.**

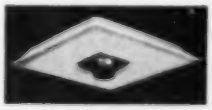
WIDE FREEDOM OF USE

In addition to all its technical advantages, SKYLIKE is modern, handsome, and versatile in application. Units fit 24" x 24" ceiling tiles, fully or partially recessed, or may be surface-mounted--in rows or patterns. With a simple accessory and a semi-silvered-bowl lamp, SKYLIKE is converted for directional or accent lighting.

AMAZINGLY LOW-COST!

Because it is so simple—simple in construction; simple in wiring; free of ballasts, starters, and accessories—SKYLIKE is low in cost (½ to ⅓ the cost of equipment delivering comparable results!). Its light weight makes for easy handling, fast installation, and lower-cost supporting construction. There's no transformer or starter maintenance. SKYLIKE can be relamped from the floor (no step-ladder!) with a lamp changer.

EASY TO CLEAN—The 87% reflection factor of SKYLIKE's enamelled ceiling is easily maintained by occasional cleaning with a damp cloth. Relamping can be done from the floor.



ACCENT LIGHTING or directional lighting is readily accomplished with SKYLIKE by the substitution of a semi-silvered-bowl lamp and a simple accessory, as shown above.

*Patent pending

Send coupon for complete data

Graybar Electric Co., Inc.
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SILVRAY Skylike

Please rush me details of Silvray SKYLIKE lighting.

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ONLY MITCHELL module LIGHTING CUSTOM-FITS

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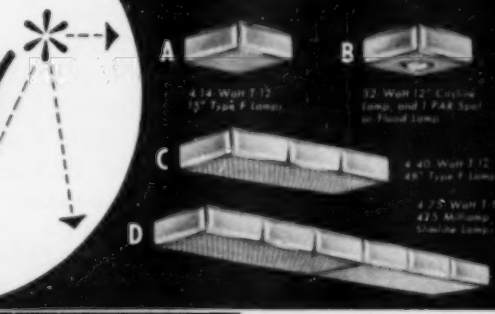
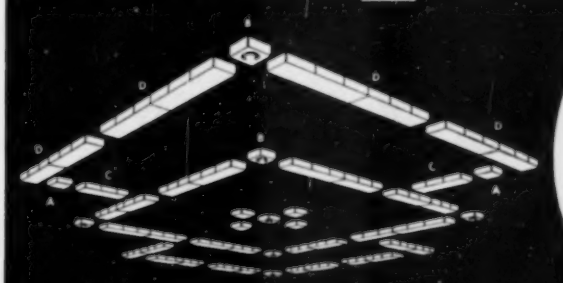
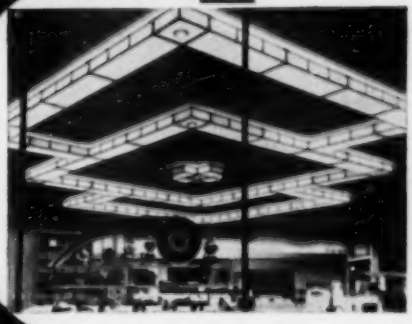
this MAGIC low-cost way

THESE 4 MODULES ARE THE "BUILDING BLOCKS" OF LIGHT



THEY FIT TOGETHER LIKE THIS... FOR LIGHTING MAGIC LIKE THIS





50,000 different patterns possible—20% more light!

Nothing in lighting compares with MODULE! Nothing in lighting matches MODULE'S custom-fitting flexibility and economical high-efficiency.

It's amazing! With just 4 simple, low cost "building blocks of light," MITCHELL MODULE offers *unlimited* custom-fitting lighting patterns to fit any commercial interior. MODULE'S exclusive plastic louver passes 20% MORE LIGHT. Simple fitting together of units (mechanically and electrically) permits low cost rearrangement of patterns at any time to suit changing needs. MODULE mixes all light sources smoothly in one harmonious, handsome system—puts the light exactly where it's needed. No ordinary fixtures can match MODULE—the *only* lighting that *custom-fits* with standard *low-cost* units.

Only MITCHELL makes MODULE

There's nothing in lighting like MODULE. It custom-fits and "grows" with every lighting need; it delivers more light; it stays beautiful, new; it costs no more than ordinary fixtures. If you haven't all the MODULE facts, write today for full descriptive details.

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YOU SELL module INSTALLATIONS WHEN YOU TELL THIS SELLING STORY

UNION METAL POLES

LUMINAIRES by Pemco

AN UNBEATABLE COMBINATION FOR YOUR COMPLETE STREET LIGHTING INSTALLATION

Shadowy corners where danger lurks or . . .
A feeling of safety and security

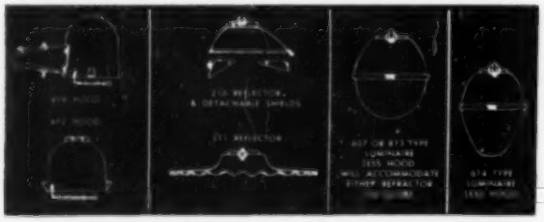
No business after dark or . . .
A busy shopping center

Gloomy streets avoided by motorists or . . .
Traffic flowing easily by

Modern lighting makes the difference. Pemco Luminaires, backed by 68 years of Street Lighting manufacturing and "know-how," will literally transform your town or city. We recommend that Pemco Luminaires be mounted on Union Metal tapered steel round or octaflute standards . . . ruggedly constructed to give a lifetime of service. Easy to install . . . require little maintenance.

Pemco 602 type Luminaire. Wet Process Porcelain Insulator, exterior binding posts, alzak reflector. Refractor or Globe.

Pemco 306 type Luminaire. Side entrance aluminum hood, asymmetric reflector.



Low-cost upkeep and replacement is paramount in modern Street Lighting practice. Interchangeable parts not only lessen the need for warehousing large stocks of maintenance equipment, but simplify changeover from one type of luminaire to another. Long-range planning with PEMCO Interchangeable Luminaires will pay big dividends in reduced future costs.

Left, Union Metal Design 6400 Round Monotube Pendent Lighting Standard with Pemco 813 Type Luminaire.

Right, Union Metal Design 6401 Octaflute Monotube Pendent Lighting Standard (transformer type base) with Pemco 813 Type Luminaire.

For information on PEMCO'S complete line of Street and Highway Lighting Equipment request PEMCO General Catalog No. 90.

PHILADELPHIA ELECTRICAL & MANUFACTURING CO.
1200-36 N. 31st Street, Philadelphia 21, Pa.
Sales Offices in Principal Cities

Continued from page 597

presents two chapters concerned with the nature, size and growth of the American Economic System. Part 2, in four chapters, presents the essentials of static theory; Part 3, in six chapters, concerns the Dynamic System, and the "condition for Progress" which embraces such practical subjects as competition and monopoly costs, profits, wages, and productivity under actual operating conditions. Part 4, nine chapters, is concerned with stability in the Dynamic System, embracing such points as the behavior of money, prices, the national income, the principles of the generations of income, business fluctuations, business cycles, and business forecasting.

Vision: Its Development in Infant and Child, by Arnold Gesell, M.D., Frances Ilg, M.D., and Glenna Bullis assisted by Viviene Ilg, O.D. and G. N. Getman, O.D.; published by Paul B. Hoeber, Inc., Medical Book Department of Harper & Bros., New York, 1949; 329 6- by 9¼ inch pages, 72 illustrations; $6.50.

This book is based on studies at the Yale Clinic of Child Development of the visual functions and skills of children from birth to ten years of age. Chapter headings are as follows:

Introductory: The eyes of today and tomorrow, Orientation: the background and scope of this study, The evolution of the human action system, The motor basis of vision

The growing Action System: The genesis of vision, Infancy, The preschool years, The school years

Developmental Optics: The visual domain, The complex of visual functions, The young eye in action, The ontogenesis of visual behavior, Maldevelopment and child vision

Development Appraisal: A developmental hygiene of child vision, The conservation of child vision

Appendix: Examination sequences and procedures, Ontogenic gradients of visual behavior

The authors show that "vision is profoundly integrated with the total action systems of the child — his posture, his manual skills and motor attitudes intelligence, and even personality make-up. The basic emphasis is on the normal aspects and the minor deviations of visual development."

Schools, by Lawrence B. Perkins and Walter D. Cocking; published by the Reinhold Publishing Corporation, 330 W. 42nd St., New York City, 1949; 264 8½- x 11½-inch pages, profusely illustrated; $10.00.

Here is another easy-to-read, informative volume of the Progressive Architecture Library. It discusses

Continued on page 25A

why use two men
to carry one 8-ft. lamp . . .
when one man can
carry eight 4-ft. lamps?

has all the advantages
of the 8-ft. lamp—
but scaled down to human, handy size

Easier Service and Maintenance

ONE MAN . . . can carry it, relamp it
mount it, maneuver it

- No starters — no starter trouble
- Virtually same lumen output per foot as 8-ft. lamps
- Easier to store
- Safer—safety codes in large national organizations require 2 men to handle anything longer than a man's height

Available in every 2 or 4 — 40W fluorescent fixture in the complete GUTH line. For full details, call your nearest GUTH Resident Engineer or write today for Bulletin 871-I

Guth LIGHTING

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Leaders in Lighting since 1902

Continued from page 24A

school building design from all aspects of interest to the architect. Fourteen pages deal with lighting, ten of which are devoted to daylighting. There are thirty illustrations included specifically to show the latest trends in lighting school buildings. However, a large percentage of the other photos and drawings throughout the book contain ideas helpful to the lighting designer.

Lighting Technique, by B. F. Fedorov; translated from the Russian by W. R. Stoker with an additional section by W. T. O'Dea; published by Hutchinson's Scientific and Technical Publications, Stratford Place, London, W.1, England; 299 5½ x 8¼-inch pages, 128 illustrations, 54 tables; price 25s.

This book, written by a leading authority in the field of electrical engineering in the U.S.S.R., covers the fundamental principles and practical aspects of illumination design. The levels of illumination mentioned are considerably below those recommended in the U.S.A., but the mathematical analyses and general design data should be helpful to American lighting engineers. More technical than many similar American texts, it is recommended for use as a reference, but not for casual reading.

Electric Lamps, published by the Lighting Service Bureau, 2 Savoy Hill, London, W.C.2, England, 1949; 147 5½ x 8½-inch pages, 107 illustrations; price 10/ including postage.

This very readable little volume was written to give those in the electrical industry "at least the rudiments of the 'how' and the 'why' of the lamps they use and sell." It contains a wealth of information on lamps produced by the Electric Lamp Manufacturers' Association of Great Britain. Introductory sections include a ten-page history of light sources followed by chapters entitled nature of light, production of light, and modern lamp making. Thereafter detailed data are presented on the mechanical and electrical construction, electrical and photometric characteristics, color, applications, and economics of available types and sizes of filament, mercury, sodium, fluorescent and miscellaneous other modern lamps.

An Index of Nomograms, by Douglas Payne Adams; published jointly by the Technology Press of Massachusetts Institute of Technology and John Wiley & Sons, Inc., New York, 1950; 174 pages; $4.00.

Continued on page 26A

Continued from page 25A

This book lists over 1700 alignment diagrams published in well-known periodicals covering a wide range of technical fields. For each nomogram included the following data are given: title, variables employed, author, periodical, month, year, volume, number and page. The 34 charts listed under illumination relate to photometry, measurement of light, daylighting, artificial lighting calculations, street lighting, residence lighting, reflectors for fluorescent lamps, and economic comparison of fluorescent and filament sources.

Gray Finishes for Industrial Apparatus and Equipment, sponsored by the Mechanical Standards Committee of the American Standards Association. Published as ASA Z55.1-1950 by ASA, 70 East 47th St., New York 17, N. Y.; eight pages, 8½ x 11 inches; plus four standard color chips; price, 35c per copy for pamphlet alone, $2.50 complete with color chips.

Representing several years of work on the part of the Illuminating Engineering Society in cooperation with 17 organizations and groups representing all classes of manufacturers and users, this American Standards specification represents an important forward step in the unified efforts of industry to reduce the number of colors for industrial apparatus, machines and equipment. General acceptance of this new standard by individual manufacturers and purchasers of industrial equipment is expected to reduce considerably the cost of finishes and finishing. Purchasers of equipment will benefit by greater ease and accuracy in specifying colors, and in securing matching colors on different equipment from different manufacturers.

Each of the four grays may be specified by a name or a number given below. The numbers indicate the approximate degree of lightness and darkness of grays. Munsell notation for hue, value and chroma accurately identifies each color.

Name	*Number*	*Munsell Notation*
Light Gray	#61 Gray	8.3G6.10/0.54
Med. Light Gray*	#49 Gray	10BG4.90/0.60
Med. Dark Gray ..	#33 Gray	7.8B3.30/0.94
Dark Gray	#24 Gray	10B2.40/1.18

*Closely approximates Machine Tool Gray (7B) a standard of the National Machine Tool Builders' Association

Contrary to the popular conception of grays, they are not necessarily variations in proportions of black and white. They may be light or dark colors with low or weak chroma (less than 1.5). Actually Light Gray is a

Continued on page 27A

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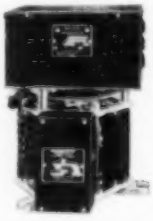

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Continued from page 26A

green, Medium Gray is a blue green, and Medium Dark and Dark Grays are blues under the more discerning "eye" of a spectrophotometer.

Color Psychology and Color Therapy, by Faber Birren; published by McGraw-Hill Book Co. Inc., New York City, 1950; 284 pages, 6 x 9 inches; price $4.50.

Introducing this work as "a factual study of the influence of color on human life," the author reports that he was motivated by two desires: first, "to assemble a wealth of data on color psychology and color therapy which has a credible basis in fact rather than fancy"; this was done by a comprehensive search into literature. Second, "with good evidence so brought together ... to appeal to science and the medical profession to abandon old prejudices and to give color its honest due." The author states that he is "convinced that a fair appraisal of color will restore its prestige in the eyes of modern medicine and will lead to great human benefit."

This generous array of data on the history of color in science and medicine presents a broad review of facts and information on its biological, psychological and visual aspects. Beginning with a description of old superstitions connected with color, this book presents an analysis of color as related to human life. It provides an interesting discussion of colors' therapeutic values, explains its effects and use in decorating and fashion work, in hospitals, in schools and factories, and in relieving fatigue and promoting safety. The author has arranged his material to show what has been done and what is being done with color, and to what more effective uses color can be put. The text is slanted especially toward modern medical practitioners, in the nature of an argument that they should recognize the importance of color and allow it to serve its beneficial purpose.

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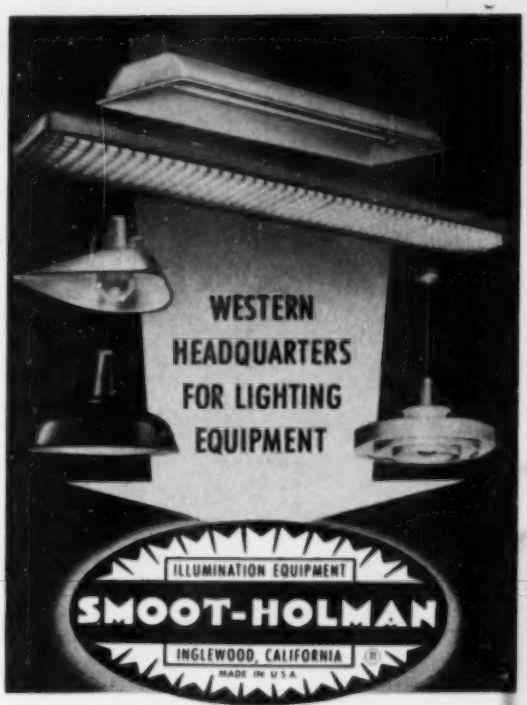

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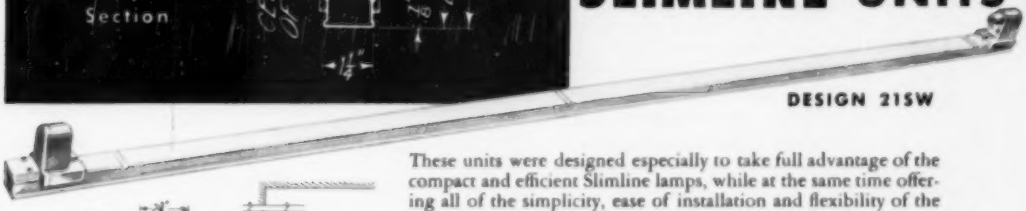

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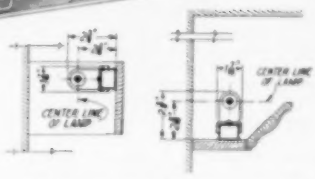

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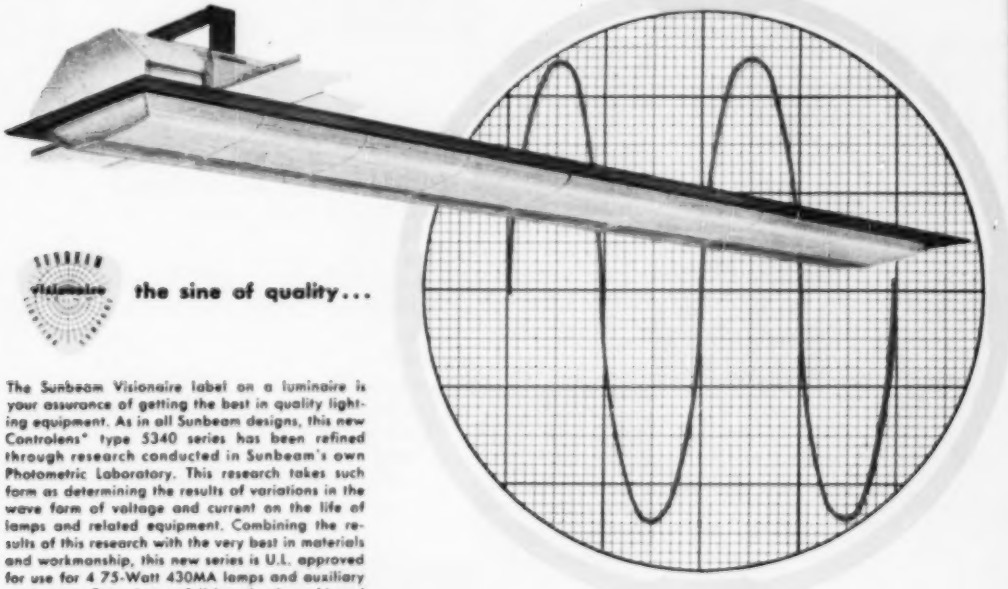

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